SOIL SURVEY OF

Bucks and Philadelphia Counties Pennsylvania

United States Department of Agriculture
Soil Conservation Service
In cooperation with
The Pennsylvania State University
College of Agriculture and the
Pennsylvania Department of Environmental Resources
State Conservation Commission

Major fieldwork for this soil survey was done in the period 1963–70. Soil names and descriptions were approved in 1971. Unless otherwise indicated, statements in this publication refer to conditions in the area in 1971. This survey was made cooperatively by the Soil Conservation Service; the Pennsylvania State University, College of Agriculture; and the Pennsylvania Department of Environmental Resources, State Conservation Commission. It is part of the technical assistance furnished to the Bucks County Conservation District. The soil survey was financed in part through local funds provided by the Bucks County Commissioners.

Copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Bucks and Philadelphia Counties contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, or recreation.

Locating Soils

All the soils of Bucks and Philadelphia Counties are shown on the detailed soil map at the back of this survey. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the area in alphabetical order by map symbol and gives the capability classification of each. It shows the page where each soil and each capability unit is described.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units.

Foresters and others can refer to the section "Use of the Soils as Woodland" for information useful in the management of woodland.

Game managers, sportsmen, and others can find information useful in the maintenance, improvement, and development of wildlife habitat in the section "Use of the Soils for Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for homes and buildings, community facilities, and recreational uses in the section "Town and Country Planning and Recreation."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and interpretations pertinent to engineering.

Scientists and others can read about soil formation and soil classification in the section "Formation, Morphology, and Classification of the Soils."

Students, teachers, and others will find information about the soils and their management in the various parts of the text, depending on their particular interests.

Newcomers in Bucks and Philadelphia Counties may be especially interested in the section "General Soil Map," where broad patterns and associations of soils are described. They may also be interested in the section "Environmental Factors Affecting Soil Use."

***Cover picture:* Historic covered bridge in a typical landscape of Bowmansville and Readington soils. Bowmansville silt loam is in the center, and Readington silt loam is in the left foreground.**

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SOIL SURVEY OF BUCKS AND PHILADELPHIA COUNTIES, PENNSYLVANIA

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SOILS SURVEYED BY EDWARD A. TOMPKINS, ALBERT D. BACKER, AND BARRIE L. WOLF, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE PENNSYLVANIA STATE UNIVERSITY, COLLEGE OF AGRICULTURE, AND THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES, STATE CONSERVATION COMMISSION

BUCKS AND PHILADELPHIA COUNTIES are in the southeast corner of Pennsylvania (fig. 1). The Delaware River forms the eastern boundary. Bucks County has a land area of 392,960 acres, and Philadelphia County has a land area of 82,240 acres. The city of Philadelphia and Philadelphia County have identical boundaries. Doylestown, the county seat of Bucks County, is about 25 miles north of Philadelphia.

The two-county area is predominantly an undulating plain characterized by low hills and ridges. Four main physiographic areas, the Coastal Plain, the Piedmont Upland, the Triassic Lowland, and the Limestone Lowland, are in the two counties. Haycock, Jericho, and Solebury Mountains and Bowmans Hill stand above local valleys in Bucks County.

The major sources of employment in the area are industrial and commercial manufacturing, wholesale and retail businesses, and farming. Numerous Interstate, U.S., and State highways, the Pennsylvania Turnpike, and the Reading and the Penn Central Railroads serve Bucks and Philadelphia Counties.

Dairying is the main source of farm income in Bucks County. Poultry products, field crops, vegetables, and livestock products are also of major importance. Philadelphia is mostly urbanized, with the exception of a few large parks. Bucks and Philadelphia Counties originally had a dense cover of trees, but the virgin stands were eliminated when the land was cleared for farming and other uses. The climate of the area is humid continental modified by the nearness to the ocean.

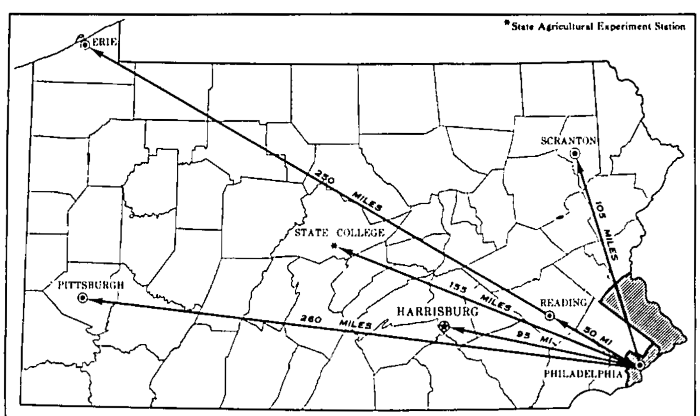

Figure 1.—Location of Bucks and Philadelphia Counties in Pennsylvania.

The soils of Bucks and Philadelphia Counties are complex and form an intricate pattern. Wetness, stoniness, depth to bedrock, and slope are the main limitations. Also, the sloping soils are subject to erosion if unprotected and if the subsoil is exposed. The limitations to use of many of these soils can be minimized by advance planning and design.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Bucks and Philadelphia Counties, where they are located, and how they can be used. The soil scientists went into the area knowing they likely would find many soils they had already seen and some they had not. They observed the steepness, length, and shape of slopes, the size of streams, the kinds of native plants or crops, the kinds of rocks, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in the soil. These layers extend from the surface down into the parent material. The lowest layers have not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in neighboring counties and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and *soil phase* are the categories of soil classification most used in this survey (*15*).[1]

All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

[1] Italic numbers in parentheses refer to Literature Cited, p. 128.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Lansdale and Chalfont, for example, are the names of two soil series.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Chalfont silt loam, 3 to 8 percent slopes, is one of two phases of the Chalfont series.

After a guide for classifying and mapping the soil had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of other soils that have been seen within an area that is predominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units, soil complexes and undifferentiated groups, are shown on the soil map of Bucks and Philadelphia Counties.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Penn-Lansdale complex, 3 to 8 percent slopes, and Culleoka-Weikert shaly silt loams, 8 to 15 percent slopes, are examples.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit, because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Manor and Chester extremely stony loams, 25 to 50 percent slopes, and Duffield and Washington soils, 8 to 20 percent slopes, are examples.

In most areas surveyed there are places where the soil material has been so drastically changed by the activities of man, or is so wet or mixed that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Urban land, Marsh, and Alluvial land are land types in Bucks and Philadelphia Counties.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Bucks and Philadelphia Counties. A soil association is a landscape that has a distinctive proportional pattern of soils. It consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in Bucks and Philadelphia Counties, who want to compare different parts of the area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

Some of the soil names and mapping unit boundaries of the Bucks and Philadelphia Counties General Soil Map do not match those of adjoining surveys, because recent changes have been made in correlation and in concepts of series and soil patterns differ from one area to another.

The 11 soil associations in Bucks and Philadelphia Counties are described in the following pages.

Deep Soils That Have a Medium-Textured Surface Layer and a Medium Textured or Moderately Fine Textured Subsoil

The six soil associations in this group make up about 48 percent of the two counties. This area includes all of Philadelphia County, the southern part of Bucks County, and the glacially influenced areas and most of the residual uplands in the northern part of Bucks County. Most of Philadelphia County and much of the southern part of Bucks County are urbanized. In the northern part of Bucks County most areas of this group are wooded, but some areas are cultivated or in pasture.

1. Allenwood association

Gently sloping to moderately steep, well-drained soils on glacially influenced uplands

This association is in three small areas of Bucks and Philadelphia Counties. Two areas are near the Lehigh-Bucks County line; the other is at Buckwampum Hill and Chestnut Hill. The association makes up about 1 percent of the total survey area. The topography is sloping to moderately steep. The soils formed in loamy glacial till or frost-churned material weathered from shale and sandstone.

This association is about 80 percent Allenwood soils and 20 percent minor soils. Allenwood soils are deep and well drained. They contain many gravel fragments that interfere with tillage. They are on hillsides and hilltops. Minor soils of the Doylestown and Readington series are at the bases of slopes and in drainageways.

The main limitation on this association is the moderately steep slope. Sites intended for intensive use need to be thoroughly investigated. Dairying is the main type of farming.

2. Chester association

Nearly level to moderately steep, well-drained soils on uplands

This association occupies Buckingham Mountain and the ridges overlooking the Durham Creek Valley. It makes up about 1 percent of the total survey area. The topography is dominantly sloping to moderately steep. The soils formed in loamy material that weathered chiefly from gneiss.

This association is made up of about 80 percent Chester soils and 20 percent minor soils. Chester soils are on tops and sides of ridges. Among the minor soils are Urbana soils at the base of slopes and in drainageways.

The main limitations to farm and nonfarm uses of this association are the moderately steep slopes and stoniness. Sites intended for intensive use need to be thoroughly investigated. Farms are dominantly dairy farms.

3. Duffield-Washington association

Gently sloping and sloping, well-drained soils in upland valleys

This association is in two small areas of limestone. One area is in the Durham Creek Valley, and the other is from Furlong to New Hope. The association makes up about 1 percent of the total survey area. The topography is gently sloping to sloping. The soils formed in loamy material that weathered chiefly from limestone.

This association is about 40 percent Duffield soils, 30 percent Washington soils, and 30 percent minor soils. Duffield soils occupy undulating landforms in the area from Furlong to New Hope (fig. 2). They are deep, well drained, and high in natural fertility. Washington soils are on hillsides and hilltops in the Durham Creek Valley. They are deep, are well drained, and have high available water capacity. Minor soils are the Alton and Hatboro soils on flood plains and the Chalfont, Clarksburg, and Lawrenceville soils at the lower elevations in the uplands.

The main limitations on this association are slope and pollution of ground water by septic tank effluent that flows through channels in the underlying limestone. The main type of farm in the Durham Creek Valley is the dairy farm. Cash-crop and general farms are dominant in the area from Furlong to New Hope, but a few places also have active limestone quarries.

4. Towhee-Neshaminy-Mount Lucas association

Nearly level to moderately steep, poorly drained to well drained soils on uplands

Most of this association is in the northern section of Bucks County, and small areas are near Point Pleasant and Bowman Hill. The association makes up about 12 percent of the total survey area. The topography is moderately steep hills and low-lying, nearly level areas between hills (fig. 3). The soils formed in loamy material weathered chiefly from diabase.

This association is about 30 percent Towhee soils, 25 percent Neshaminy soils, 12 percent Mount Lucas soils, and 33 percent minor soils. Towhee soils are poorly drained and restricted in permeability. They are in concave positions at the base of slopes and in depressions. Neshaminy soils are deep and well drained. They are on hills, ridges, and side slopes. Mount Lucas soils are moderately well drained and somewhat poorly drained and have a firm subsoil that is restricted in permeability. Mount Lucas soils are at smooth, concave lower elevations between Neshaminy and Towhee soils. The major soils of this association are naturally extremely stony. Among the minor soils are Doylestown and Lehigh soils on the outer fringes of the association and Hatboro soils on flood plains.

The main limitations for farm and nonfarm uses are slope, stoniness, the seasonal high water table, and restricted permeability. Sites intended for intensive use need to be thoroughly investigated. Large parts of this association are in woodland or are idle. Some large acreages are Pennsylvania State Game Lands, and some areas are county and State parks.

areas are county and State parks.

Figure 2.—Typical landscape of Duffield silt loam in the Duffield-Washington soil association.

5. Urban land-Chester association

Nearly level to sloping, well-drained land types and soils on uplands

This association is in the southern part of Bucks County and in the northern half of Philadelphia County. It makes up about 16 percent of the total survey area. The topography is nearly level to sloping. The soils formed in loamy material weathered chiefly from gneiss and schist.

This association is about 45 percent Urban land, 30 percent Chester soils, and 25 percent minor soils. Urban land consists of areas that are built up and occupied by urban structures and works. Most foundation materials consist of Chester and other soils that have been obscured, smoothed, disturbed, filled in, or destroyed by construction of urban facilities (fig. 4). Urban land mainly occupies the gentler slopes. Chester soils are deep, well drained, and moderately permeable. They are on the tops and sides of ridges. Among the minor soils are Chalfont, Duncannon, Lawrenceville, and Manor soils in various upland positions and Hatboro and Rowland soils on flood plains.

Urban development precludes the use of Urban land for other purposes. The main limitations on Chester soils and the minor soils are slope and stoniness. Sites intended for intensive use need to be thoroughly investigated.

6. Urban land-Howell association

Nearly level and gently sloping, well-drained land types and soils on terraces

This association is in the southern part of both Bucks and Philadelphia Counties. It makes up about 17 percent of the total survey area. The topography is nearly level to gently sloping. The soils formed in loamy and clayey material of mixed, old Coastal Plain sediment.

This association is about 55 percent Urban land, 15 percent Howell soils, and 30 percent minor soils and low areas of Marsh (fig. 5). Urban land is a land type that consists of areas that are built up and occupied by urban structures and works. Most foundation materials consist of Howell and other soils that have been obscured, smoothed, disturbed, filled in, or destroyed by construction of urban facilities. Urban land occupies all positions within the association. Howell soils are deep, well drained, and moderately slowly permeable. They occupy upper convex positions on terraces on the

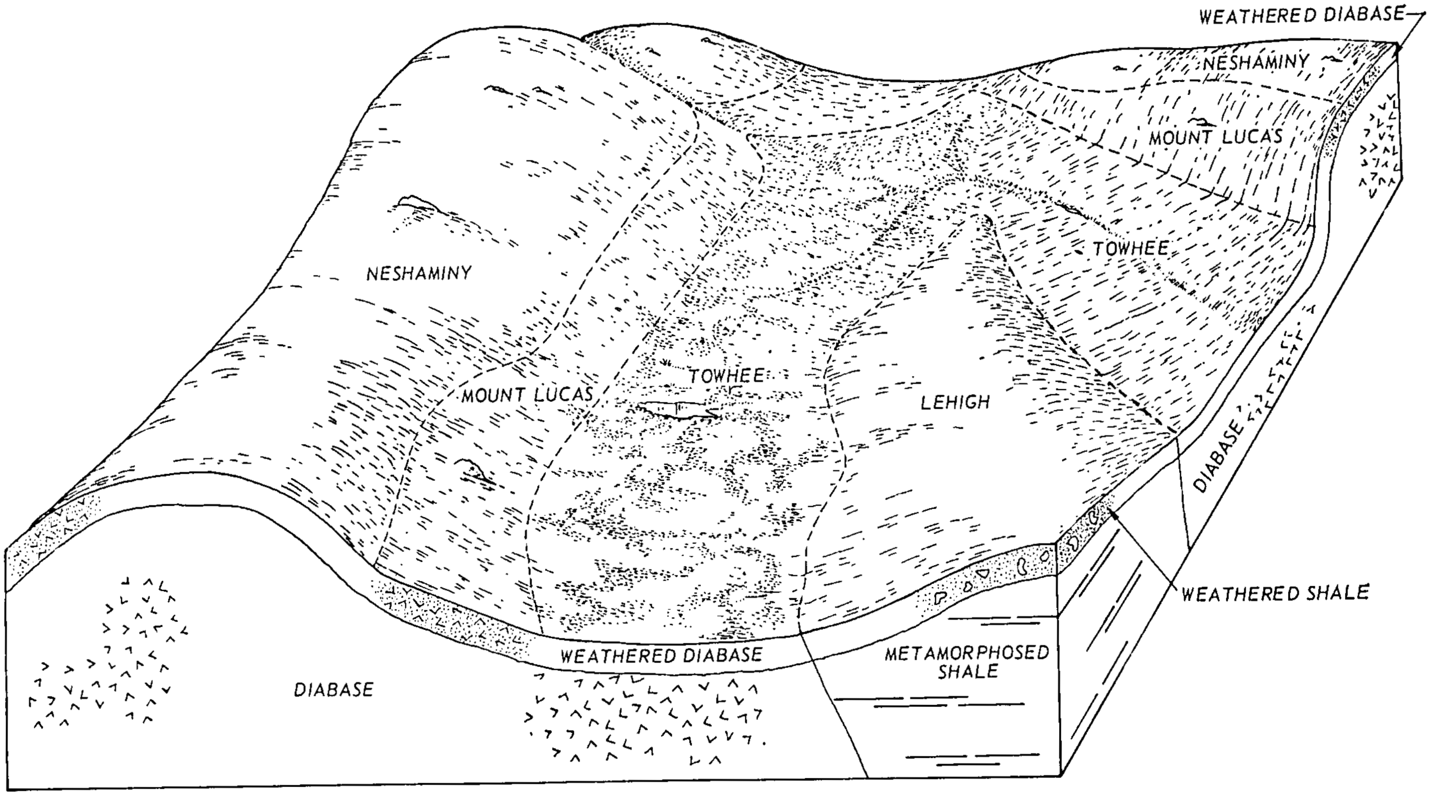

Figure 3.—**Typical pattern of soils and underlying material in the Towhee-Neshaminy-Mount Lucas soil association.**

Coastal Plain. Among the minor soils are Doylestown, Duncannon, Fallsington, Lawrenceville, and Woodstown soils on uplands; Alton and Pope soils on high bottom lands; and Hatboro soils on flood plains.

Urban development precludes the use of Urban land for other purposes. The main limitation in Howell soils and minor soils is the restricted permeability. Sites intended for intensive use need to be thoroughly investigated.

Figure 4.—**Typical landscape in the Urban land-Chester soil association. Chester soils are in the foreground, and the houses in the background are on Urban land.**

Soils That Have a Medium-Textured Surface Layer and a Firm to Friable, But Mainly Firm and Compact, Subsoil; Shallow to Deep Over Shale or Sandstone

This group consists of three soil associations that make up about 35 percent of Bucks and Philadelphia Counties. These soils are mostly in the central part of Bucks County, and smaller areas are in the northern and northeastern parts of Bucks County. Most of the acreage is cultivated or in pasture.

7. *Abbottstown-Doylestown-Reaville association*

Nearly level and gently sloping, moderately deep and deep, poorly drained to moderately well drained soils on uplands

This association is in one large area and one small area in Bucks County. The large area is a 7- to 9-mile band from the Montgomery County line at Hilltown and West Rockhill Townships to the Delaware River in Plumstead Township. The small area is near Quakertown. This is the largest of the soil associations and makes up about 22 percent of the total survey area. The topography is dominantly nearly level and gently sloping. Low ridges and valleys are oriented east-west (fig. 6). The soils formed in loamy and silty material that weathered chiefly from shale and sandstone.

This association is about 25 percent Abbottstown soils, 15 percent each Doylestown and Reaville soils, and 45 percent minor soils. Abbottstown soils are deep and somewhat poorly drained and are restricted in permeability. They have a compact subsoil and a seasonal high

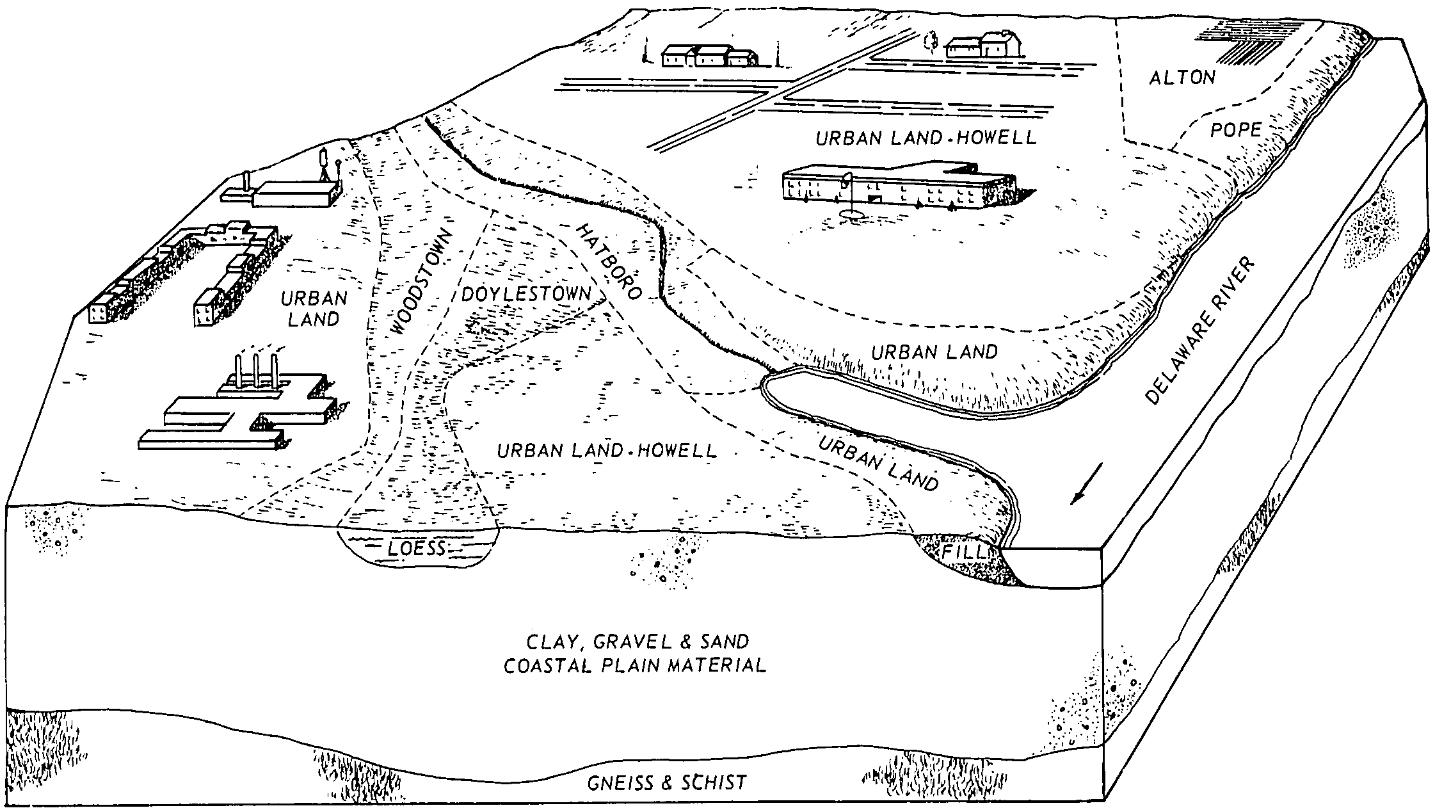

Figure 5.—Typical pattern of soils and underlying material in the Urban land-Howell soil association.

water table. They are at the base of slopes, on side slopes, and on broad ridgetops. Doylestown soils are deep and poorly drained. They have a very compact subsoil and restricted permeability. They are in depressions at the base of slopes and on broad upland flats. Reaville soils are moderately deep, are moderately well drained to somewhat poorly drained, and have a seasonal high water table. Reaville soils are on the tops and sides of ridges. Among the minor soils are Bedington, Klinesville, Penn, and Readington soils on uplands; Bowmansville and Rowland soils on flood plains; and Urban land.

The main limitations on this association are a high water table, restricted permeability, and depth to bedrock. Sites intended for intensive use need to be thoroughly investigated. Dairy farms are dominant, but cash-crop farming has increased as urbanization has reduced the acreage available for cash crops in the southern part of Bucks County.

8. *Abbottstown-Readington-Reaville association*

Nearly level to sloping, moderately deep and deep, somewhat poorly drained and moderately well drained soils on uplands

This association is south of Doylestown in a 4- to 6-mile band that extends from the Montgomery County line near Eureka to the Delaware River near Washington Crossing. It makes up about 10 percent of the total survey area. The topography varies from nearly level to sloping. The stronger slopes are short and lead to the many drainageways that traverse the area (fig. 7). The soils in this association formed in loamy material weathered from shale and sandstone.

This association is about 18 percent Abbottstown soils, 12 percent Readington soils, 10 percent Reaville soils, and 60 percent minor soils. The soil pattern is detailed and complex. Abbottstown soils are deep, somewhat poorly drained, and restricted in permeability. They have a compact subsoil and a seasonal high water table. Readington soils are deep and moderately well drained and are similar to the Abbottstown soils. Abbottstown and Readington soils are at the base of slopes, on side slopes, and on ridgetops. Reaville soils are moderately deep, shaly, moderately well drained to somewhat poorly drained, and restricted in permeability. They have a seasonal high water table. They are on the tops and sides of ridges. Among the minor soils are well-drained Bedington, Culleoka, Duncannon, Klinesville, Lansdale, Penn, and Weikert soils on uplands; Chalfont, Doylestown, and Lawrenceville soils that have restricted drainage; Bowmansville and Rowland soils on flood plains; and some Urban land.

The main limitations on this association are restricted permeability, seasonal high water table, and depth to bedrock. Sites intended for intensive use need to be thoroughly investigated. Farming is diversified and consists of dairy, cattle, and cash-crop farms. Many large estates are in the association. Many stone quarries are in this association in Bucks County.

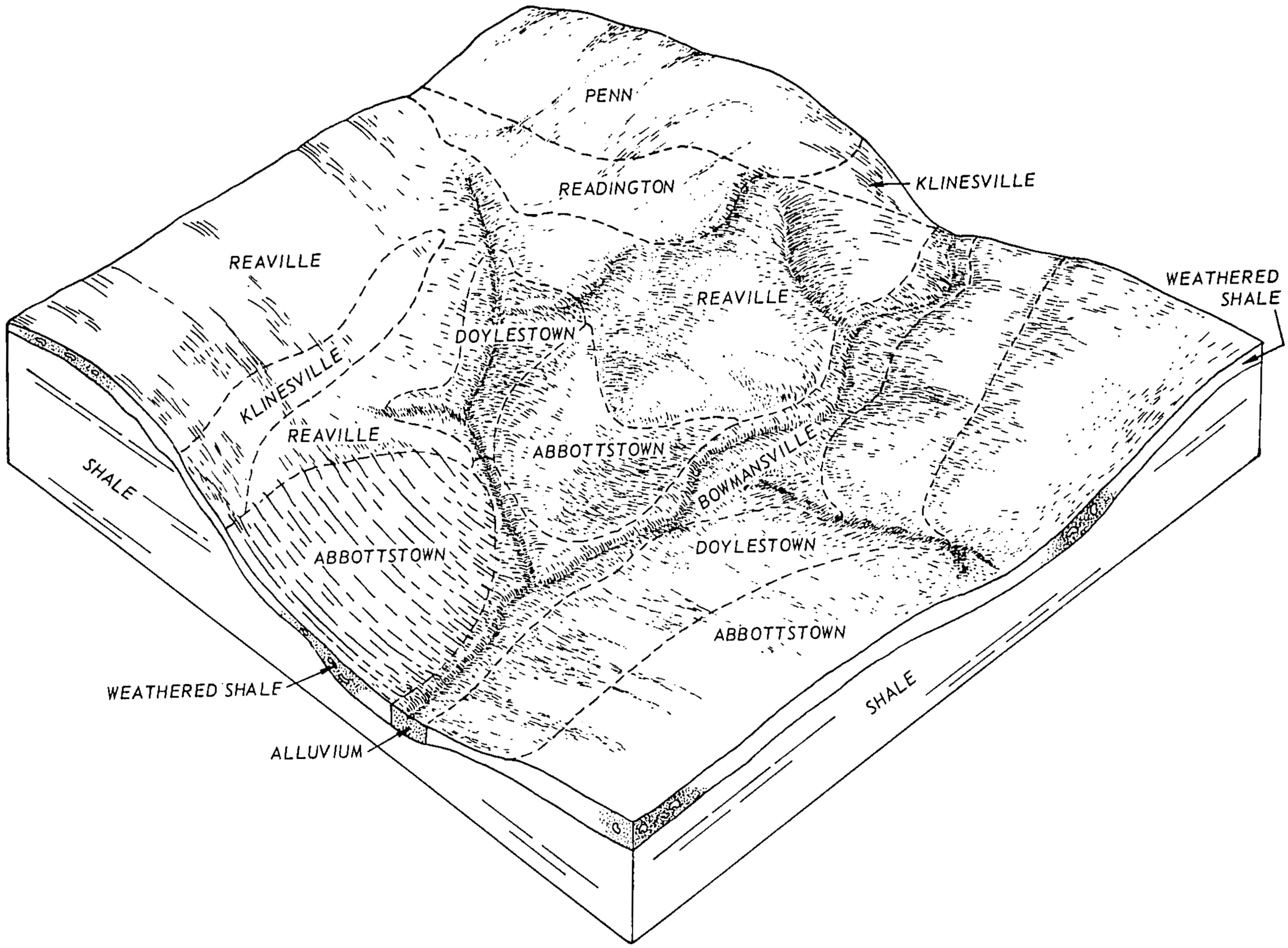

Figure 6.—**Typical pattern of soils and underlying material in the Abbottstown-Doylestown-Reaville soil association.**

9. Penn-Klinesville association

Nearly level to moderately steep, shallow and moderately deep, well-drained soils on uplands

This association is in four small areas in the northern half of Bucks County. It makes up about 3 percent of the total survey area. Topography is dominantly sloping to moderately steep (fig. 8). The soils formed chiefly in material weathered from red shale and sandstone.

This association is about 35 percent each Penn and Klinesville soils and 30 percent minor soils. Penn soils are moderately deep and well drained. Klinesville soils are shallow and well drained. Both Penn and Klinesville soils are on upper slopes and hilltops. Minor soils are the Abbottstown, Doylestown, and Readington soils at low elevations in the uplands and on nearly level hill tops and the Bowmansville and Rowland soils on flood plains.

The main limitations on this association are steep slopes and depth to bedrock. Sites intended for intensive use need to be thoroughly investigated. The main type of farm is the dairy farm.

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Deep Soils That Have a Medium Textured Surface Layer and a Medium Textured or Moderately Coarse Textured Subsoil

The two soil associations in this group make up about 17 percent of the two counties. They mainly form an east-west band across the south-central part of Bucks County, but they are also on the high bottom lands along the Delaware River. Much of the area is urbanized or is used for crops or pasture.

10. Alton-Pope association

Nearly level to gently sloping, well-drained soils on terraces and flood plains

This association is on the high bottom lands along the Delaware River from Riegelsville to Tullytown. It makes up about 2 percent of the total survey area. The topography is nearly level to gently sloping (fig. 9). The soils formed in loamy and very gravelly alluvial and outwash sediment derived chiefly from shale, sandstone, and limestone.

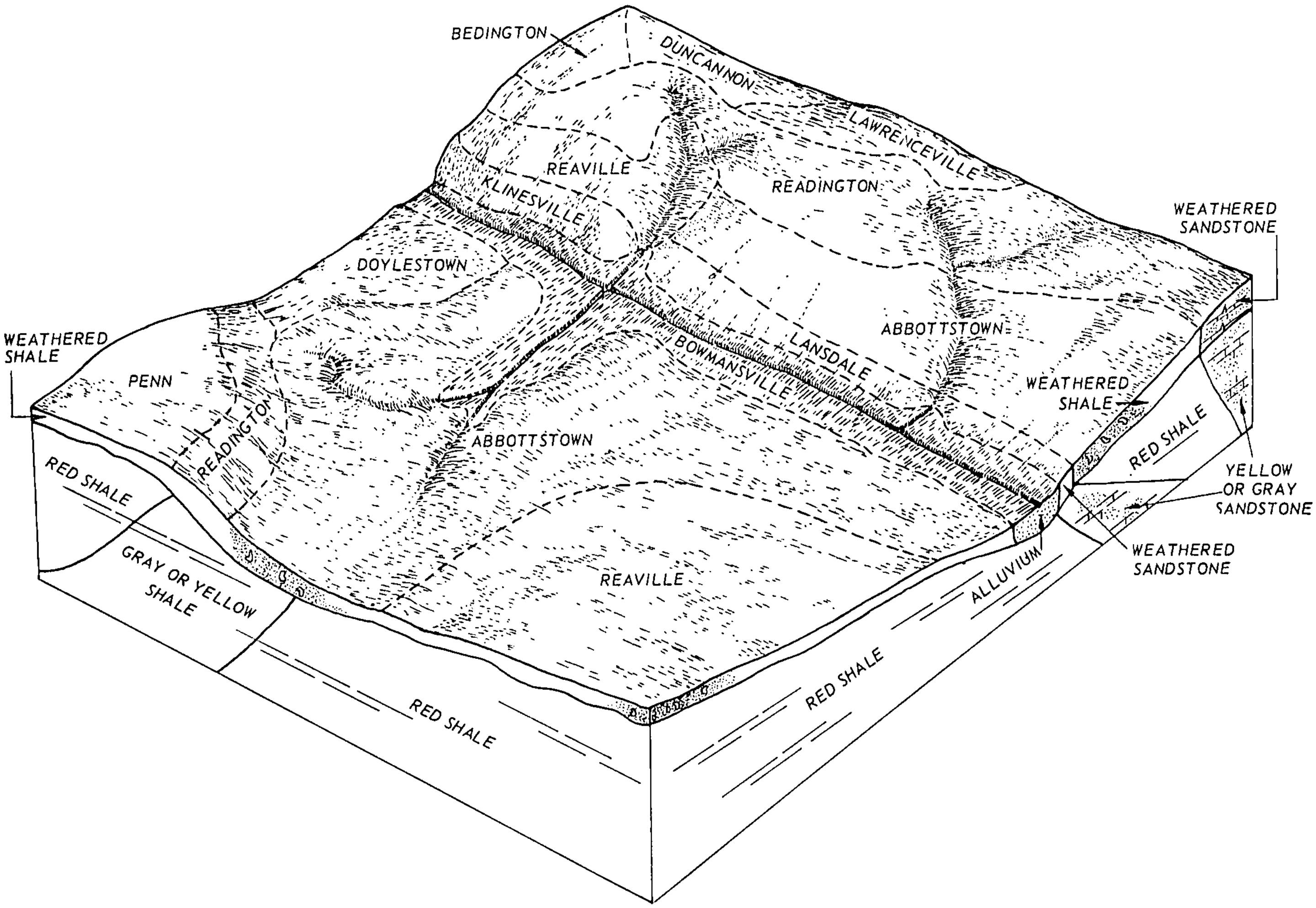

Figure 7.—**Typical pattern of soils and underlying material in the Abbottstown-Readington-Reaville soil association.**

This association is about 45 percent Alton soils, 40 percent Pope soils, and 15 percent minor soils. Alton soils are gravelly and droughty. Most of the deep and well-drained Alton and Pope soils north of Morrisville are subject to flooding. In this association are minor areas of Bowmansville soils, Marsh, and Urban land. The Bowmansville soils are in depressions on narrow flood plains adjacent to uplands.

The main limitations on this association are droughtiness and flooding. Sites intended for intensive use need to be thoroughly investigated. Alton soils are a good source of gravel.

11. Lansdale-Lawrenceville association

Nearly level to sloping, moderately well drained and well drained soils on uplands

This association is in two areas. One area extends from west of Doylestown to the Delaware River at Stockton. The other area is in a 3- to 6-mile band from the Montgomery County line in Warminster Township to Yardley on the Delaware River. This association makes up about 15 percent of the total survey area. The topography ranges from nearly level to gently sloping in valleys to sloping on ridges (fig. 10). The soils formed in material weathered from shale and sandstone and in silty, windblown deposits.

This association is about 35 percent Lansdale soils, 15 percent Lawrenceville soils, and 50 percent minor soils. Lansdale soils are deep, well drained, and moderately rapidly permeable. They are on the tops and upper sides of ridges. Lawrenceville soils are deep and moderately well drained. They have a compact subsoil that is restricted in permeability. They are at lower elevations and in valleys. Minor soils are well-drained Klinesville, Penn, and Steinsburg soils on ridges and at steeper elevations; Abbottstown, Chalfont, Doylestown, and Readington soils in valleys; well-drained Bedington and Duncannon soils in valleys; Bowmansville and Rowland soils on flood plains; and Urban land.

The main limitations on this association are a seasonal high water table and restricted permeability. Sites intended for intensive use need to be thoroughly investigated. Use of this association for industry and housing developments is increasing. Dairy, beef-cattle, and cash-crop farms are dominant.

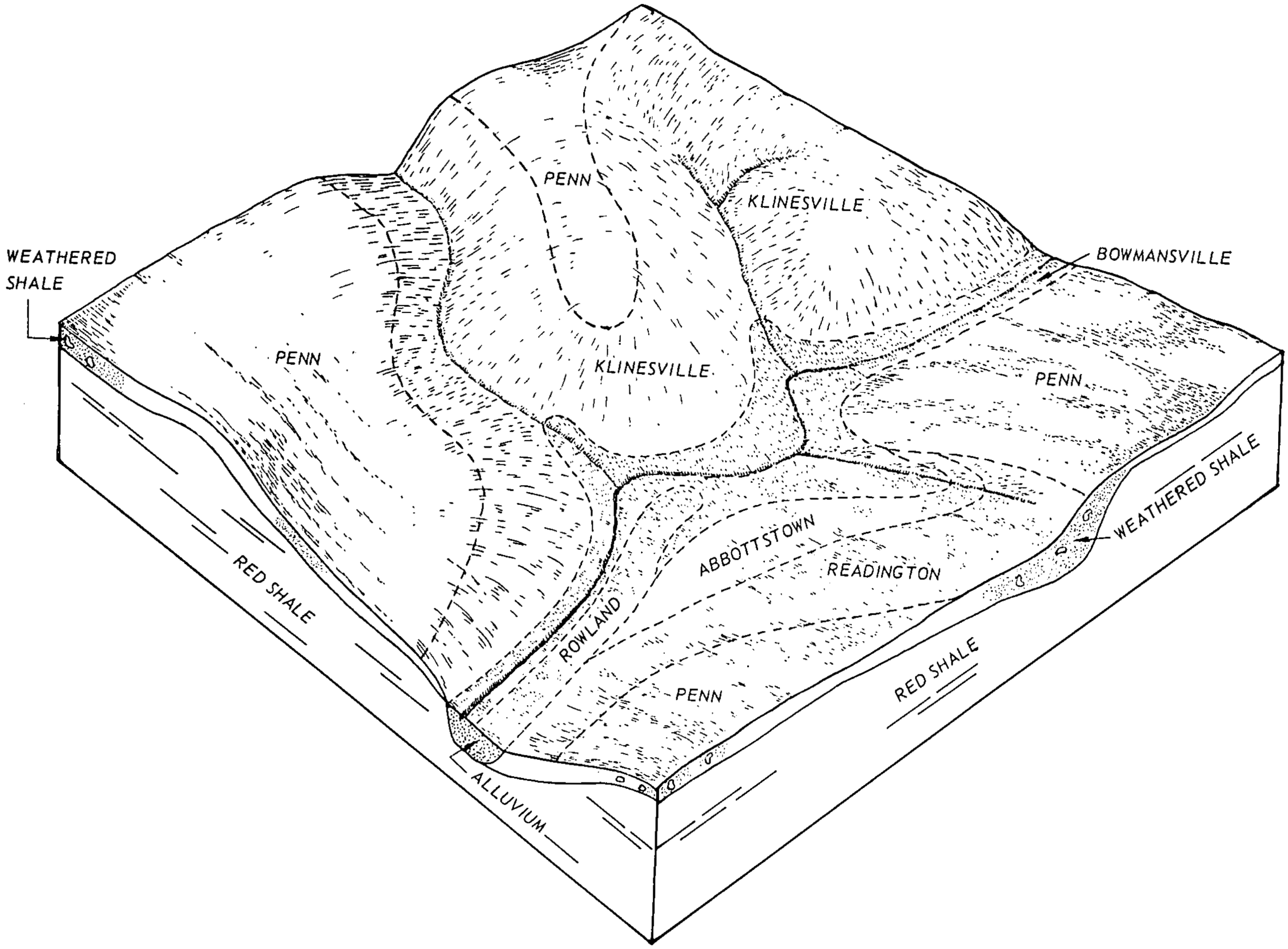

Figure 8.—Typical pattern of soils and underlying material in the Penn-Klinesville soil association.

Use and Management of the Soils

This section describes various uses and systems of management of the soils of Bucks and Philadelphia Counties. It suggests use and management of the soils for field crops, pasture, woodland, and wildlife. It provides data on engineering properties of the soils and interpretations of these properties as they affect engineering uses, and it explains the limitations of the soils for uses related to town and country planning and recreation.

Management of Field Crops and Pasture [2]

The capability classification system used by the Soil Conservation Service is explained in this part of the survey, and management of the soils is defined by capability unit groupings. Yields are estimated for crops commonly grown in the area.

[2] Prepared in cooperation with ROBERT L. BOND, conservation agronomist, Soil Conservation Service.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, the kinds of soils are grouped at three levels: the capability class, the subclass, and the unit. These levels are defined in the following paragraphs.

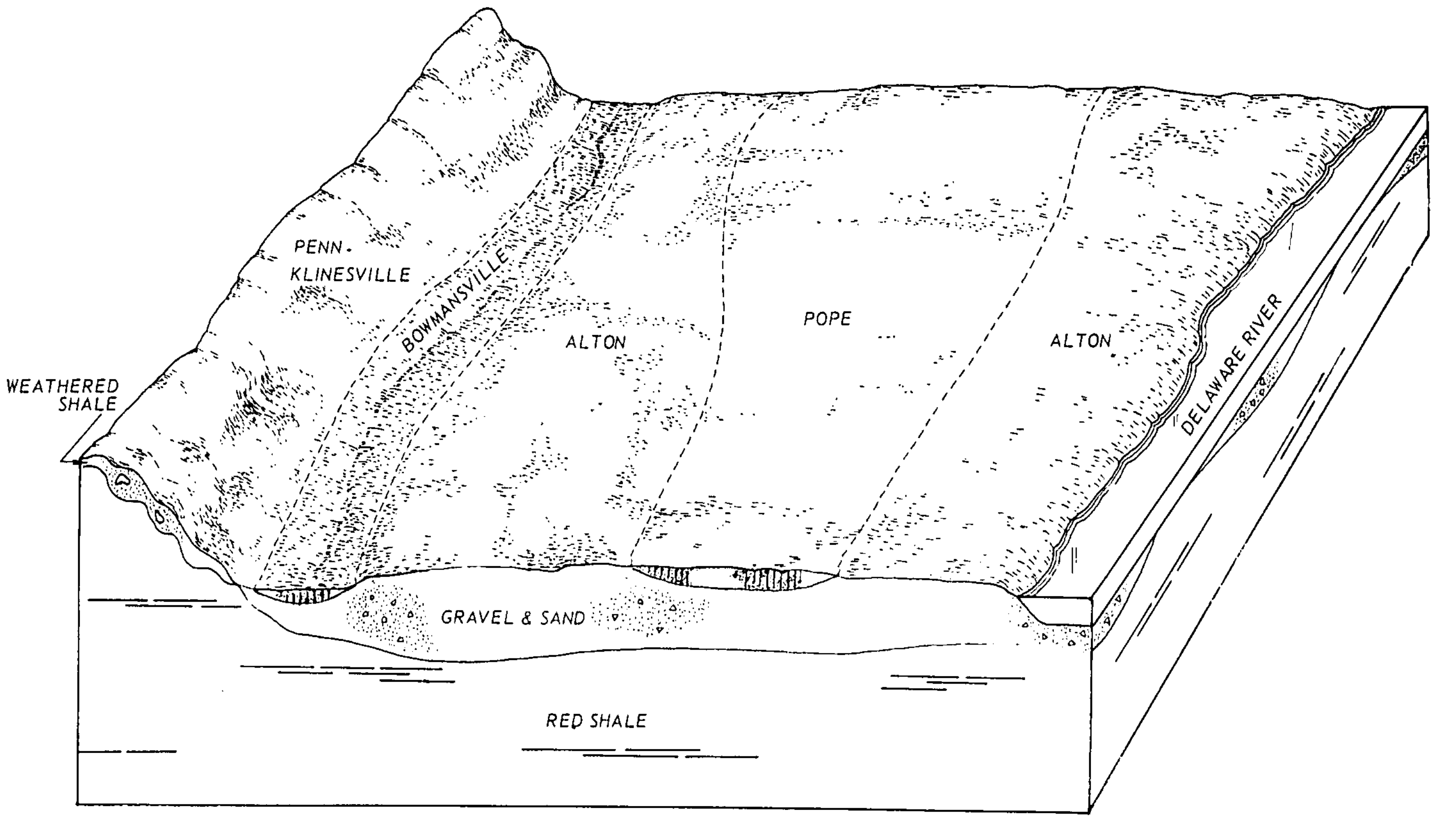

Figure 9.—**Typical pattern of soils and underlying material in the Alton-Pope soil association and the adjacent Penn-Klinesville association.**

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have a few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat. (No class V soils are in Bucks and Philadelphia Counties.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife, and water supply or to esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold to too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability

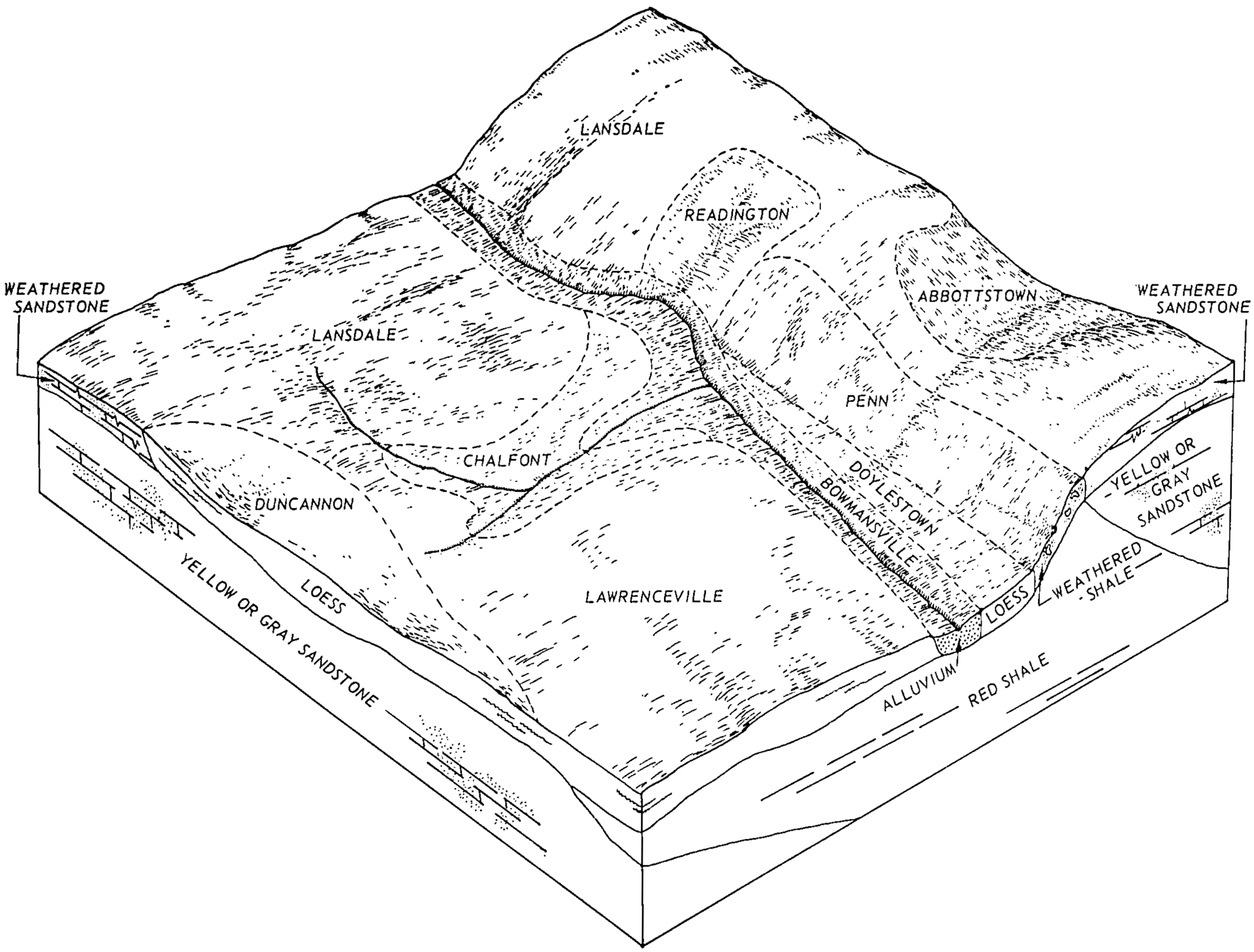

Figure 10.—Typical pattern of soils and underlying material in the Lansdale-Lawrenceville soil association.

unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation, and the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraphs. The Arabic numeral specifically identifies the capability unit within each subclass.

In Bucks and Philadelphia Counties all soils and land types are grouped into specific capability units except for Urban land and Urban land complexes. Urban land is not used or managed for the production of field crops or pasture.

All soils in one capability unit have about the same limitations and similar risks of damage. The soils in one unit, therefore, need about the same kind of management, though they may have formed in different kinds of parent material and in different ways. Fundamental to good soil management is the selection of a cropping system and the application of practices that help maintain and improve soil productivity. This depends on the nature of the soils.

Controlling erosion, removing excess water on many soils, maintaining fertility and tilth, and conserving moisture are common needs in the management of farms in the area. Many soils have a seasonal high water table because a fragipan restricts downward movement of water. Such soils have a limited root zone. Other soils are contour stripcropping and the use of diversions and coarse grained in texture.

Practices that help control erosion on sloping soils are contour strip cropping and the use of diversions and terraces (fig. 11), graded strips, and grassed waterways (fig. 12). Soils that have subsurface water can be improved by using an underground random tile drainage system or open drainage ditches where outlets are available. Other practices helpful in maintaining and improving soil productivity are the growing of winter cover crops, stubble mulching, minimum tillage, and the grow-

Figure 11.—**Diversion and contour stripcropping on Penn silt loam, 3 to 8 percent slopes. The diversion intercepts surface water and helps protect the soil from erosion.**

ing of green manure crops. Such practices are needed most where cropping is intensive or where cultivation is continuous.

The main crops of the area are corn; hay crops of alfalfa, timothy, and clover; small grain; soybeans; and truck crops. Lime and fertilizer should be applied according to soil tests and the needs of the crops. Most crops respond very well to additions of lime and fertilizer.

Additional help in managing the soils can be obtained by consulting the local representative of the Soil Conservation Service, the County Extension Service, or members of the staff of the State Agricultural Experiment Station.

The names of soil series represented are mentioned in the description of each capability unit, but this does not mean that all soils of a given series appear in the unit. To find the names of all the soils and the capability unit to which each one has been assigned, refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT I-1

Pope loam, terrace, 0 to 3 percent slopes, is the only soil in this capability unit. It is a deep, well-drained soil on stream terraces. It is easy to till. Permeability is moderately rapid, and available water capacity is high. Natural reaction is medium acid or slightly acid.

This soil has few limitations and is well suited to most crops commonly grown in the area. Growing cover crops and green manure crops, utilizing crop residue, and including hay in the cropping system help maintain the organic-matter content of the soil and improve tilth.

CAPABILITY UNIT I-2

This capability unit consists of nearly level, deep, well-drained soils on uplands. These are soils of the Bedington, Chester, and Duncannon series. They are easy to till. Permeability is moderate, and available water capacity is high. Duncannon soils contain fewer coarse fragments than Bedington and Chester soils. Natural reaction is strongly acid to slightly acid.

These soils have few limitations and are well suited to most crops commonly grown in the area. Growing cover crops and green manure crops, utilizing crop residue, and including hay in the cropping system help maintain the organic-matter content of the soils and improve tilth.

CAPABILITY UNIT I-3

This capability unit consists of nearly level, deep, well-drained soils of the Howell and Lansdale series. The Howell soils are on terraces on the Coastal Plain, and the Lansdale soils are on uplands. These soils are easy to till. Permeability is slow to moderately rapid, and

Figure 12.—Waterway constructed alongside an urban development on Abbottstown silt loam carries excess surface water from the housing area and helps control erosion.

available water capacity is moderate or high. Natural reaction is very strongly acid or strongly acid.

These soils have few limitations and are well suited to most crops commonly grown in the area. Growing cover crops and green manure crops, utilizing crop residue, and including hay in the cropping system help maintain the organic-matter content of the soils and improve tilth.

CAPABILITY UNIT IIe-1

Pope loam, terrace, 3 to 10 percent slopes, the only soil in this capability unit, is a deep, well-drained soil on stream terraces. It is easy to till. Permeability is moderately rapid, and available water capacity is high. Runoff is medium, and the hazard of erosion is moderate. Natural reaction is medium acid or slightly acid.

This soil is well suited to most crops commonly grown in the area, but some soil-conserving practices are needed to protect it from erosion and deterioration. Contour strips, terraces, diversions, grassed waterways, and hay crops help in controlling runoff and erosion.

CAPABILITY UNIT IIe-2

This capability unit consists of gently sloping, deep, well-drained soils on uplands. These are soils of the Bedington, Chester, Duffield, Duncannon, Neshaminy, and Washington series. They are easy to till. Permeability is moderately slow or moderate, and available water capacity is moderate or high. Runoff is medium, and the hazard of erosion is moderate. Natural reaction is strongly acid to slightly acid.

These soils are well suited to most crops commonly grown in the area, but some soil-conserving practices are needed to protect them from erosion and deterioration. Contour strips (fig. 13), terraces, diversions, grassed waterways, and hay crops help in controlling runoff and erosion.

CAPABILITY UNIT IIe-3

This capability unit consists of gently sloping, deep, well-drained soils on uplands and terraces on the Coastal Plain. These soils are of the Allenwood, Howell, and Lansdale series. They are easy to till. Permeability is moderately slow to moderately rapid, and available water capacity is moderate or high. Runoff is medium, and the hazard of erosion is moderate. Natural reaction is very strongly acid or strongly acid.

These soils are well suited to most crops commonly grown in the area, but some soil-conserving practices are needed to protect them from erosion and deterioration. Contour strips, terraces, diversions, grassed waterways, and hay crops help control runoff and erosion.

CAPABILITY UNIT IIe-4

This capability unit consists of gently sloping, deep and moderately deep, well-drained soils on uplands. These are soils of the Lansdale, Manor, Penn, and

Figure 13.—**Alternating strips of corn and hay on a typical landscape of Bedington silt loam, 3 to 8 percent slopes.**

Steinsburg series. They are easy to till, but are somewhat droughty. Permeability is moderate or moderately rapid, and available water capacity is moderate or low. Runoff is medium, and the hazard of erosion is moderate. Natural reaction is very strongly acid to slightly acid.

These soils are suited to most crops commonly grown in the area, but some soil-conserving practices are needed to protect them from erosion and deterioration. Contour strips, terraces, cover crops, green manure crops, crop residue, diversions, grassed waterways, and hay crops help conserve water and control erosion.

CAPABILITY UNIT IIe-5

This capability unit consists of gently sloping, deep, moderately well drained and somewhat poorly drained soils on uplands. These are soils of the Clarksburg, Lawrenceville, Mount Lucas, Readington, and Urbana series. Permeability is moderately slow or slow, and available water capacity is moderate or high. These soils have a seasonal water table that sometimes delays tillage in spring or during wet periods. The root zone is limited by a firm layer in the lower part of the subsoil. Runoff is medium, and the hazard of erosion is moderate. Natural reaction is very strongly acid to slightly acid.

These soils are suited to most crops commonly grown in the area, but some soil-conserving practices are needed to protect them from erosion and deterioration. Graded strips, diversions, terraces, grassed waterways, and hay crops help to reduce runoff and control erosion. Alfalfa tends to winterkill in long stands. Winter grain also is affected at times by frost heaving. Random tile drains remove excess subsurface water and permit earlier cultivation in spring.

CAPABILITY UNIT IIw-1

This capability unit consists of nearly level, deep, well drained and moderately well drained soils on flood plains. These soils are of the Pope and Rowland series. They are subject to short-duration flooding that generally occurs each year early in spring or late in fall, before or after the growing season. Pope soils are flooded less frequently than Rowland soils, and flooding is of shorter duration. Rowland soils also have a water table late in winter and early in spring. These soils are easy to till, but tillage is delayed during some wet seasons. Permeability is moderately slow to moderately rapid, and the available water capacity is high. Natural reaction is slightly acid to very strongly acid.

These soils are suited to most crops commonly grown in the area. Growing cover crops and green manure crops, utilizing crop residue, and including hay in the cropping system maintain the organic-matter content and improve tilth. Keeping natural drainageways open and providing outlets in depressions improve drainage.

CAPABILITY UNIT IIw-2

This capability unit consists of nearly level, deep, moderately well drained and somewhat poorly drained soils on uplands. These are soils of the Lawrenceville, Mount Lucas, Readington, Urbana, and Woodstown series. Permeability is slow to moderate, and available water capacity is moderate or high. These soils have seasonal water tables that sometimes delay tillage during wet periods. They also warm slowly in spring. Roots are restricted by a firm layer in the subsoil. Natural reaction is extremely acid to slightly acid.

These soils are suited to most crops commonly grown in the area. Including hay in the cropping system helps to control wetness. Legumes and winter grain are affected at times by frost heaving. Random tile drains remove excess subsurface water. Surface drainage can be improved by keeping natural drainageways open and by providing outlets in depressions.

CAPABILITY UNIT IIs-1

Penn silt loam, 0 to 3 percent slopes, the only soil in this capability unit, is a moderately deep, well-drained soil underlain by fractured shale bedrock. Is is on uplands. It is easy to till, but tends to be somewhat droughty. Permeability and available water capacity are moderate. Natural reaction is very strongly acid or strongly acid.

This soil is suited to most crops commonly grown in the area, but the root zone is restricted to about 35 inches over bedrock. Cover crops, green manure crops, crop residue, and hay crops conserve moisture, maintain organic-matter content, and improve tilth.

CAPABILITY UNIT IIIe-1

This capability unit consists of sloping, deep, well-drained soils on uplands. These soils are of the Bedington, Chester, Duffield, Neshaminy, and Washington series. They are easy to till. Permeability is moderately slow or moderate, and available water capacity is moderate or high. Runoff is medium, and the hazard of erosion is high. Natural reaction is strongly acid to slightly acid.

These soils are suited to most crops commonly grown in the area if they are protected from erosion. Contour stripcropping, growing cover crops and green manure crops, utilizing crop residue, using diversions and grassed waterways, and including hay and other close-growing crops in the cropping system help control runoff and protect the soils from erosion and deterioration.

CAPABILITY UNIT IIIe-2

This capability unit consists of sloping, deep, well-drained soils on uplands. These are soils of the Allenwood and Lansdale series. They are easy to till. Permeability is moderate or moderately rapid, and available water capacity is moderate or high. Runoff is medium, and the hazard of erosion is high. Natural reaction is very strongly acid or strongly acid.

These soils are suited to most crops commonly grown in the area if they are protected from erosion. Contour strips, cover crops, green manure crops, crop residue, diversions, and grassed waterways, and hay and other close-growing crops help control runoff and protect the soils from erosion and deterioration.

CAPABILITY UNIT IIIe-3

This capability unit consists of sloping, moderately deep and deep, well-drained soils on uplands. These soils are of the Lansdale, Manor, Penn, and Steinburg series. They are easy to till, but are somewhat droughty. Permeability is moderate or moderately rapid, and available water capacity is moderate or low. Runoff is medium, and the hazard of erosion is high. Natural reaction is very strongly acid to slightly acid.

These soils are suited to most crops commonly grown in the area if they are protected from erosion. Contour strips, cover crops, green manure crops, crop residue, diversions, grassed waterways, and hay and other close-growing crops help conserve moisture, control surface runoff, and protect the soils from erosion and deterioration. Bedrock at a depth of 20 to 40 inches interferes at times with the construction of diversions on Penn and Steinsburg soils.

CAPABILITY UNIT IIIe-4

This capability unit consists of moderately deep and shallow, well-drained, gently sloping soils on shale uplands. These soils are of the Culleoka, Klinesville, Penn, and Weikert series. They are easy to till, but they are droughty. Permeability is moderate to moderately rapid, and available water capacity is low or very low. Runoff is medium, and the hazard of erosion is moderate. Natural reaction is very strongly acid to slightly acid.

These soils are suited to the more drought-resistant crops commonly grown in the area if they are protected from erosion. In the Klinesville and Weikert soils the root zone is less than 20 inches over bedrock, and in the Culleoka and Penn soils it is 20 to 40 inches. Contour strips, cover crops, green manure crops, crop residue, diversions, grassed waterways, and hay and other close-growing crops help conserve moisture, control runoff, and protect the soils from erosion and deterioration. In places bedrock interferes with the construction of diversions on all these soils.

CAPABILITY UNIT IIIe-5

This capability unit consists of sloping, deep, moderately well drained and somewhat poorly drained soils on uplands. These soils are of the Mount Lucas and Readington series. They have a seasonal water table that sometimes delays tillage in spring or during wet periods. Roots are restricted by a firm layer in the lower part of the subsoil. Permeability is moderately slow or slow, and available water capacity is moderate or high. Runoff is medium, and the hazard of erosion is high. Natural reaction is strongly acid to slightly acid.

These soils are suited to most crops commonly grown in the area if they are protected from erosion. Alfalfa and winter grain are sometimes damaged by frost heave.

Graded strips, diversions, grassed waterways, and hay and other close-growing crops help in controlling runoff and erosion. Random tile drains remove excess subsurface water.

CAPABILITY UNIT IIIe-6

This capability unit consists of sloping, deep, somewhat poorly drained and moderately well drained soils on uplands. These soils are of the Abbottstown and Lehigh series. They have a seasonal water table that sometimes delays tillage in spring or during wet periods. Roots are restricted by a firm layer in the subsoil. Permeability is slow, and available water capacity is moderate. Runoff is medium, and the hazard of erosion is high. Natural reaction is strongly acid to neutral.

These soils are suited to water-tolerant crops if they are protected from erosion. Alfalfa tends to die out early. Graded strips, diversions, grassed waterways, and hay and other close-growing crops help to control runoff and erosion. Random tile drains remove excess subsurface water.

CAPABILITY UNIT IIIw-1

This capability unit consists of nearly level and gently sloping, deep, somewhat poorly drained and moderately well drained soils on uplands. These are soils of the Abbottstown, Chalfont, and Lehigh series. They have a seasonal water table and are wet, especially in spring. Roots are restricted by a firm layer in the subsoil. Permeability is slow, and available water capacity is moderate. Runoff is slow or medium, and the hazard of erosion is slight or moderate. Natural reaction is strongly acid to neutral.

These soils are suited to water-tolerant crops. Legumes and winter grain winterkill easily. Including hay in the cropping system helps to control wetness. Excess surface water can be drained by keeping natural drainageways open or by using open ditches. Graded strips, grassed waterways, and diversions help to control runoff and erosion on the gently sloping soils. Random tile drains remove excess subsurface water.

CAPABILITY UNIT IIIw-2

Fallsington silt loam, gravelly subsoil variant, the only soil in this capability unit, is a nearly level, deep, poorly drained soil on terraces on the Coastal Plain. It has a high water table and is wet most of the year. Permeability is moderate, and available water capacity is moderate. Natural reaction is strongly acid or very strongly acid.

Drained areas of this soil are suited to water-tolerant crops. Including hay in cropping systems helps to control wetness. Excess water can be removed by using underground tile drains, by keeping natural drainageways open, and by bedding or using open ditches. Drainage outlets are difficult to obtain on this soil.

CAPABILITY UNIT IIIw-3

This capability unit consists of nearly level and gently sloping, moderately deep, moderately well drained and somewhat poorly drained soils on uplands underlain by fractured shale bedrock. These are soils of the Reaville series. They have a seasonal water table that sometimes delays tillage in spring or during wet periods. They are droughty during dry seasons. Permeability is slow, and available water capacity is low. Runoff is slow or medium, and the hazard of erosion is slight to moderate. Natural reaction is strongly acid.

These soils are used only for those crops that tolerate wetness in spring and droughtiness later in the growing season. Alfalfa tends to die out early. Growing cover crops and green manure crops, utilizing crop residue, and including hay and close-growing crops in the cropping system help in conserving moisture and in controlling runoff and erosion. Graded strips, diversions, and grassed waterways on gently sloping soils also help control runoff and erosion. In places bedrock interferes with the construction of diversions.

CAPABILITY UNIT IIIw-4

Alton gravelly loam, flooded, 0 to 5 percent slopes, the only soil in this capability unit, is a deep, well-drained gravelly soil on high bottom lands along streams. It is easy to till, but is subject to flooding and is also droughty. Permeability is rapid, and available water capacity is low. Natural reaction is strongly acid to medium acid.

This soil is suited to the more drought-resistant crops commonly grown in the area. Cover crops, green manure crops, crop residue, and hay and other close-growing crops help conserve moisture. Hay is not so susceptible to flood damage as are grain or other crops.

CAPABILITY UNIT IIIs-1

This capability unit consists of nearly level and gently sloping soils on gravelly outwash terraces. These are deep, well-drained soils of the Alton series. They are easy to till, but are gravelly and droughty. Permeability is rapid, and available water capacity is low. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Natural reaction is strongly acid to medium acid.

These soils are suited to the more drought-resistant crops commonly grown in the area. Contour strips, cover crops, green manure crops, crop residue, and hay crops conserve moisture and also help in controlling runoff and erosion in gently sloping areas.

CAPABILITY UNIT IVe-1

This capability unit consists of moderately steep, deep, well-drained soils on uplands. These soils are of the Allenwood, Chester, and Lansdale series. They are easy to till. Permeability is moderate or moderately rapid, and available water capacity is moderate or high. Runoff is rapid, and the hazard of erosion is high. Natural reaction is very strongly acid or strongly acid.

These soils need careful management because they are subject to erosion. They can be cultivated if the cropping system is of low intensity and includes a year of long-term hay, pasture, or orchards. Stripcrops, cover crops, green manure crops, crop residue, diversions, and grassed waterways also protect the soils against runoff, erosion, and deterioration.

CAPABILITY UNIT IVe-2

This capability unit consists of moderately steep, deep and moderately deep, well-drained soils on uplands.

These are soils of the Manor, Penn, and Steinsburg series. They are easy to till, but are somewhat droughty. Permeability is moderate or moderately rapid, and available water capacity is moderate or low. Runoff is rapid, and the hazard of erosion is high. Natural reaction is very strongly acid to slightly acid.

Careful management is needed to protect these soils against erosion. Cultivated crops can be grown if the cropping system is of low intensity and includes long-term hay or pasture. Stripcrops, cover crops, green manure crops, crop residue, diversions, and grassed waterways help conserve moisture and protect the soils against runoff, erosion, and deterioration. The bedrock at a depth of 20 to 40 inches in Penn and Steinsburg soils interferes with the construction of diversions.

CAPABILITY UNIT IVe-3

This capability unit consists of sloping, moderately deep and shallow, well-drained soils on shale uplands. These soils are of the Culleoka, Klinesville, Penn, and Weikert series. They are droughty, but are easy to till. Permeability is moderate or moderately rapid, and available water capacity is low or very low. Runoff is medium, and the hazard of erosion is high. Natural reaction is very strongly acid to slightly acid.

Careful management is needed to protect these soils against erosion. Severe limitations restrict use to the more drought-resistant crops. The soils can be cultivated if the cropping system is of low intensity and includes long-term hay or pasture (fig. 14). Stripcrops, cover crops, green manure crops, crop residue, diversions, and grassed waterways help in conserving moisture, controlling runoff, and protecting the soils from erosion and deterioration. In places bedrock interferes with the construction of diversions.

CAPABILITY UNIT IVe-4

Reaville shaly silt loam, 8 to 15 percent slopes, the only soil in this capability unit, is a moderately well drained or somewhat poorly drained soil on uplands. It is moderately deep over fractured shale bedrock. It has a seasonal water table and is sometimes wet in spring and droughty during dry seasons. Permeability is slow, and available water capacity is low. Runoff is medium, and the hazard of erosion is high. Natural reaction is strongly acid.

Careful management is needed to protect this soil against erosion. Very severe limitations restrict use to water-tolerant crops in spring and drought-resistant crops later in the growing season. The soil can be cultivated if the cropping system is of low intensity and includes long-term hay or pasture. Cover crops, green manure crops, crop residue, graded strips, diversions, and grassed waterways help in conserving moisture and controlling runoff and erosion. In places bedrock interferes with the construction of diversions.

Figure 14.—Typical landscape of Penn-Klinesville complex, 8 to 15 percent slopes, eroded, in pasture.

CAPABILITY UNIT IVw-1

This capability unit consists of nearly level, deep, poorly drained soils on flood plains. These are soils of the Bowmansville and Hatboro series. They have a high water table, are wet most of the year, and are subject to flooding. Permeability is moderate or moderately slow, and available water capacity is high. Natural reaction is very strongly acid to slightly acid.

Wetness and flooding severely limit the use of these soils for crops. A very low intensity cropping system that includes moisture-tolerant hay and pasture crops is needed. A water-tolerant row crop can be grown occasionally, but it has to be planted after the water table has receded late in spring or early in summer. Drainage can be improved by keeping natural drainageways open, by providing outlets for depressions, by bedding, by using random tile drains, or by using open ditches if outlets are available.

CAPABILITY UNIT IVw-2

This capability unit consists of nearly level and gently sloping, deep, poorly drained soils on low-lying uplands. These soils are of the Doylestown and Towhee series. They have a high water table and are wet most of the year. Permeability is slow, and available water capacity is moderate to high. Roots are restricted by a firm layer in the subsoil. Water is ponded in some areas during wet seasons. Natural reaction is strongly acid to neutral.

The hazard of wetness is a very severe limitation if this unit is used for crops. A very low intensity cropping system that includes moisture-tolerant hay and pasture crops is needed. Drainage can be improved by keeping natural drainageways open, by bedding, by using open ditches or random tile drains, and by diverting surface water.

CAPABILITY UNIT VIe-1

This capability unit consists of moderately steep, shallow and moderately deep, well-drained shaly soils on uplands. These are soils of the Culleoka, Klinesville, and Weikert series. Permeability is moderately rapid, and available water capacity is low or very low. Runoff is rapid, and the hazard of erosion is high. Natural reaction is very strongly acid to slightly acid.

A combination of factors including a high erosion hazard, steep slopes, and a restricted root zone over bedrock make these soils unsuitable for cultivation. Use is restricted largely to pasture, woodland, or wildlife habitat.

CAPABILITY UNIT VIIs-1

This capability unit consists of nearly level to moderately steep, shallow to deep, well-drained, extremely stony soils on uplands. These soils are of the Chester, Klinesville, Lansdale, Manor, Neshaminy, and Penn series. Permeability is moderately slow to moderately rapid, and available water capacity is low to high. Runoff is slow to rapid, and the hazard of erosion is slight to high.

These soils are too stony to be cultivated. Their use is restricted largely to woodland and wildlife habitat.

CAPABILITY UNIT VIIs-2

This capability unit consists of nearly level to moderately steep, deep, somewhat poorly drained and moderately well drained, extremely stony soils on uplands. These soils are of the Lehigh and Mount Lucas series. Permeability is slow, and available water capacity is moderate to high. Runoff is slow to rapid, and the hazard of erosion is slight to high.

These soils are too stony to be cultivated. Their use is restricted largely to woodland (fig. 15) and wildlife habitat.

CAPABILITY UNIT VIIs-3

This capability unit consists of steep and very steep, shallow to deep, well-drained, extremely stony soils on uplands. These soils are of the Chester, Klinesville, Lansdale, Manor, Neshaminy, and Penn series. Permeability is moderately slow to moderately rapid, and available water capacity is very low to high. Runoff is rapid, and the hazard of erosion is high.

These soils are too stony and steep to be cultivated. Their use is restricted largely to woodland and wildlife habitat.

CAPABILITY UNIT VIIs-4

This capability unit consists of nearly level or gently sloping, deep, poorly drained, extremely stony soils on low-lying uplands and associated flood plains. These are soils of the Towhee series and Alluvial land. Permeability is moderately slow or slow, and available water capacity is moderate or high. The water table is at or near the surface during most of the year, or areas are frequently flooded.

These soils are too stony and generally too wet to be cultivated. Their use is restricted largely to woodland and wildlife habitat.

CAPABILITY UNIT VIIIw-1

Only the land type Marsh is in this capability unit. Marsh is in depressions on tidal flats and inland areas of the Coastal Plain. It is very wet or covered with water much of the time.

It is restricted largely to wildlife habitat, recreation, or esthetic uses.

Estimated yields

Table 1 shows estimated yields for representative field crops, specialty crops, and hay and pasture. These estimates reflect current averages for a period of 10 years or more.

Yields are estimated for two levels of management. In columns A are yields to be expected under the average management practiced on most farms in the area. In columns B are yields that can be obtained in an average growing season under improved management. The yields shown in table 1 are not intended to indicate maximum yields obtainable.

Improved management consists of planting adapted varieties of crops; applying fertilizer and lime in the amounts indicated by the results of soil tests; using currently recommended practices to control weeds, insects, and diseases; and using practices that help to control erosion and that safely remove excess surface water and excess internal water. Minimum tillage, contour tillage, stripcropping, management of crop resi-

Figure 15.—Typical area of Mount Lucas extremely stony silt loam in woodland.

due, and adequate drainageways, waterways, and diversions help in erosion control. Information about other suitable practices can be obtained locally from the Soil Conservation Service and the Agricultural Extension Service. Irrigation is not considered in estimating the yields. Yields can be expected to increase as new methods and new varieties of crops are developed, but the relative yields on the different soils are not expected to change.

Use of the Soils as Woodland [3]

Bucks and Philadelphia Counties originally had a dense cover of trees. Clearing for housing and farming, however, in addition to cutting for commercial purposes has eliminated all of the virgin stands of timber. Philadelphia County has no commercial forest (*19*). The trees along the streets and in the many parks are valued for esthetic and recreational purposes, for screening out noise, and for pollution abatement. It is essential that these trees are maintained and that others are planted.

Bucks County is about 25 percent commercial woodland that consists of second- and third-growth stands. Following are the principal forest cover types and the proportionate extent of each (*19*):

	Percentage of total commercial woodland in Buck County
Virginia and pitch pine	3
Virginia pine is pure or predominant. Principal associates are white oak, chestnut oak, red oak, black oak, red maple, and pitch pine.	
Oak and hickory	58
White oak, red oak, and hickory predominate, although black oak is prominent in places. Principal associates are yellow-poplar, shagbark hickory, white ash, red maple, beech, and black gum. The understory is flowering dogwood.	
Elm, ash, and red maple	17
White ash, American elm, and red maple predominate. Principal associates are slippery elm, yellow birch, black gum, sycamore, and hemlock.	
Sugar maple, beech, and yellow birch	17
Sugar maple, beech, and yellow birch are the component species. Associated species are mixtures of basswood, red maple, hemlock, northern red oak, ash, white pine, black birch, and yellow-poplar.	
Aspen and gray birch	3
Quaking aspen, bigtooth aspen, and gray birch predominate in mixture. Principal associates are pin cherry, red maple, yellow and paper birch, white pine, ash, and sugar maple.	
Other oak types	2

Sawtimber occupies about 52 percent of the acreage in commercial forests; poletimber, 29 percent; and

[3] By V. C. Miles, woodland specialist, Soil Conservation Service.

TABLE 1.—*Estimated yields per acre of principal*

[Figures in columns A are the yields to be expected under normal management; figures in columns B are those to be expected under improved in this table are not suited to

Soil	Corn				Soybeans	
	Grain		Silage			
	A	B	A	B	A	B
	Bu	*Bu*	*Tons*	*Tons*	*Bu*	*Bu*
Abbottstown silt loam, 0 to 3 percent slopes	50	95	10	19	16	32
Abbottstown silt loam, 3 to 8 percent slopes	50	95	10	19	16	32
Abbottstown silt loam, 8 to 15 percent slopes	50	90	10	18	------	------
Allenwood gravelly silt loam, 3 to 8 percent slopes	70	110	14	22	24	36
Allenwood gravelly silt loam, 8 to 15 percent slopes	65	100	13	20	22	34
Allenwood gravelly silt loam, 15 to 25 percent slopes	50	90	10	18	------	------
Alton gravelly loam, 0 to 3 percent slopes	50	90	10	18	------	------
Alton gravelly loam, 3 to 8 percent slopes	50	90	10	18	------	------
Alton gravelly loam, flooded, 0 to 5 percent slopes	------	75	------	15	------	------
Bedington silt loam, 0 to 3 percent slopes	75	130	15	26	26	44
Bedington silt loam, 3 to 8 percent slopes	75	130	15	26	26	44
Bedington silt loam, 8 to 15 percent slopes	70	120	14	24	24	40
Bowmansville silt loam	70	115	14	23	24	38
Chalfont silt loam, 0 to 3 percent slopes	50	95	10	19	16	32
Chalfont silt loam, 3 to 8 percent slopes	50	95	10	19	16	32
Chester silt loam, 0 to 3 percent slopes	90	135	18	27	30	46
Chester silt loam, 3 to 8 percent slopes	85	135	17	27	28	46
Chester silt loam, 8 to 15 percent slopes	80	125	16	25	26	42
Chester silt loam, 15 to 25 percent slopes	75	100	15	20	------	------
Clarksburg silt loam 2 to 6 percent slopes	55	105	11	21	18	34
Culleoka-Weikert shaly silt loams, 3 to 8 percent slopes	50	70	10	14	------	------
Culleoka-Weikert shaly silt loams, 8 to 15 percent slopes	50	65	10	13	------	------
Doylestown silt loam, 0 to 3 percent slopes	40	75	8	15	------	------
Doylestown silt loam, 3 to 8 percent slopes	40	75	8	15	------	------
Duffield silt loam, 2 to 8 percent slopes	85	135	17	27	28	46
Duffield and Washington soils, 8 to 20 percent slopes	80	125	16	25	26	42
Duncannon silt loam, 0 to 3 percent slopes	85	135	17	27	28	46
Duncannon silt loam, 3 to 8 percent slopes	85	135	17	27	28	46
Fallsington silt loam, gravelly subsoil variant	50	105	10	21	16	34
Hatboro silt loam	50	95	10	19	------	------
Howell silt loam, 0 to 3 percent slopes	75	130	15	26	26	44
Howell silt loam, 3 to 8 percent slopes	75	130	15	26	26	44
Klinesville very shaly silt loam, 3 to 8 percent slopes	------	60	------	12	------	------
Klinesville very shaly silt loam, 8 to 15 percent slopes	------	------	------	------	------	------
Klinesville very shaly silt loam, 15 to 25 percent slopes	------	------	------	------	------	------
Lansdale loam, 0 to 3 percent slopes	75	125	15	25	26	42
Lansdale loam, 3 to 8 percent slopes	75	125	15	25	26	42
Lansdale loam, 8 to 15 percent slopes	65	110	13	22	22	35
Lansdale loam, 15 to 25 percent slopes	60	100	12	20	------	------
Lawrenceville silt loam, 0 to 3 percent slopes	55	105	11	21	18	34
Lawrenceville silt loam, 3 to 8 percent slopes	55	105	11	21	18	34
Lehigh channery silt loam, 2 to 8 percent slopes	50	95	10	19	16	32
Lehigh channery silt loam, 8 to 18 percent slopes	50	90	10	18	16	30
Manor loam, 3 to 8 percent slopes	65	95	13	19	22	32
Manor loam, 8 to 15 percent slopes	60	90	12	18	20	30
Manor loam, 15 to 25 percent slopes	50	80	10	16	------	------
Mount Lucas silt loam, 0 to 3 percent slopes	55	105	11	21	18	34
Mount Lucas silt loam, 3 to 8 percent slopes	55	105	11	21	18	34
Mount Lucas silt loam, 8 to 15 percent slopes	50	100	10	20	16	32
Neshaminy channery silt loam, 3 to 8 percent slopes	85	135	17	27	28	46
Neshaminy channery silt loam, 8 to 15 percent slopes	80	125	16	25	26	42
Penn silt loam, 0 to 3 percent slopes	65	95	13	19	22	32
Penn silt loam, 3 to 8 percent slopes	65	95	13	19	22	32
Penn silt loam, 8 to 15 percent slopes	60	90	12	18	20	30
Penn silt loam, 15 to 25 percent slopes	55	80	11	16	------	------
Penn-Klinesville shaly silt loams, 3 to 8 percent slopes, eroded	------	60	------	12	------	------
Penn-Klinesville complex, 8 to 15 percent slopes, eroded	------	------	------	------	------	------
Penn-Lansdale complex, 3 to 8 percent slopes	70	105	14	19	24	34
Penn-Lansdale complex, 8 to 15 percent slopes	60	90	12	18	20	30
Pope loam, 0 to 5 percent slopes	105	140	21	28	34	46

See footnote at end of table.

crops under two levels of management

management. Absence of data indicates that soil is not suited to the specified crop at the specified level of management. Soils not listed cultivated crops or tame pasture]

Wheat		Tomatoes		Sweet corn		Hay				Pasture			
						Alfalfa-grass mixture		Grass-legume mixture		Blue grass		Tall grass	
A	B	A	B	A	B	A	B	A	B	A	B	A	B
Bu	*Bu*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]
----	----	----	----	----	4.5	----	----	1.4	3.0	55	135	70	170
----	----	----	----	----	4.5	----	----	1.4	3.0	55	135	70	170
----	----	----	----	----	----	----	----	1.4	3.0	55	135	70	170
30	40	23	28	3.4	5.5	2.9	4.0	2.0	3.0	80	135	145	230
25	35	----	----	----	----	2.8	4.0	2.0	3.0	80	135	140	230
25	30	----	----	----	----	2.7	3.5	1.9	2.5	75	115	135	200
30	40	----	----	----	----	2.1	4.0	1.0	3.0	40	135	105	230
30	40	----	----	----	----	2.1	4.0	1.0	3.0	40	135	105	230
----	----	----	----	----	----	----	----	1.0	2.5	40	115	50	145
40	50	23	28	3.4	5.5	2.9	5.0	2.0	3.5	80	160	145	285
40	50	23	28	3.4	5.5	2.9	5.0	2.0	3.5	80	160	145	285
35	45	----	----	----	----	2.8	4.5	2.0	3.5	80	160	140	255
----	----	----	----	3.1	5.4	----	----	2.3	3.5	90	160	115	200
----	----	----	----	----	4.5	----	----	1.4	3.0	55	135	70	170
----	----	----	----	----	4.5	----	----	1.4	3.0	55	135	70	170
40	50	27	30	4.2	6.0	4.0	5.5	2.5	3.5	100	160	200	315
40	50	26	29	4.0	5.8	4.0	5.5	2.4	3.5	95	160	200	315
35	45	----	----	----	----	3.5	5.0	2.3	3.5	90	160	175	285
30	35	----	----	----	----	3.0	4.0	2.2	3.0	90	135	150	230
30	40	18	24	2.8	4.7	2.3	3.5	1.7	3.0	70	135	115	200
20	30	----	----	----	----	2.0	3.0	1.6	2.5	65	115	100	170
15	25	----	----	----	----	1.8	2.5	1.3	2.0	50	90	90	145
----	----	----	----	----	----	----	----	1.4	2.5	55	115	70	145
----	----	----	----	----	----	----	----	1.4	2.5	55	115	70	145
40	50	26	29	4.0	5.8	3.5	5.5	2.3	3.5	90	160	175	315
35	45	----	----	----	----	3.3	5.0	2.3	3.5	90	160	165	285
45	50	26	29	4.0	5.8	3.5	5.5	2.3	3.5	90	160	175	315
40	50	26	29	4.0	5.8	3.5	5.5	2.3	3.5	90	160	175	315
----	----	----	----	----	----	----	----	1.7	3.0	70	135	85	170
----	----	----	----	----	----	----	----	1.4	3.0	----	----	70	170
40	50	23	28	3.4	5.5	3.0	5.5	2.0	3.5	80	160	150	315
40	50	23	28	3.4	5.5	3.0	5.5	2.0	3.5	80	160	150	315
20	25	----	----	----	----	1.5	2.5	1.2	2.0	50	90	75	145
15	20	----	----	----	----	1.4	2.5	1.1	2.0	45	90	70	145
----	----	----	----	----	----	----	----	----	----	30	60	----	----
35	50	24	29	3.6	5.7	3.0	5.0	2.0	3.5	80	160	150	285
35	50	23	28	3.4	5.5	3.0	5.0	2.0	3.5	80	160	150	285
30	45	----	----	----	----	2.8	4.5	2.0	3.0	80	135	140	255
25	40	----	----	----	----	2.7	4.0	1.9	2.5	75	115	135	230
30	45	17	24	2.6	4.7	2.1	3.5	1.7	3.0	70	135	105	200
30	45	17	24	2.6	4.7	2.3	3.5	1.7	3.0	70	135	115	200
----	----	----	----	----	4.5	----	----	1.4	3.0	55	135	70	170
----	----	----	----	----	----	----	----	1.4	3.0	55	135	70	170
30	40	21	25	3.1	5.0	2.6	3.5	1.8	3.0	70	135	130	200
25	35	----	----	----	----	2.5	3.0	1.8	2.5	70	115	125	170
20	30	----	----	----	----	2.4	3.0	1.7	2.0	70	90	120	170
30	45	17	24	2.6	4.7	2.1	3.5	1.7	3.0	70	135	105	200
30	45	17	24	2.6	4.7	2.3	3.5	1.7	3.0	70	135	115	200
25	40	----	----	----	----	2.3	3.5	1.7	3.0	70	135	115	200
45	50	26	29	4.0	5.8	3.5	5.5	2.3	3.5	90	160	175	315
35	45	----	----	----	----	3.3	5.0	2.3	3.5	90	160	175	285
35	40	19	22	3.0	4.4	2.7	3.5	1.9	3.0	75	135	135	200
35	40	19	22	3.0	4.4	2.7	3.5	1.9	3.0	75	135	135	200
30	35	----	----	----	----	2.6	3.0	1.8	2.5	70	115	130	170
25	30	----	----	----	----	2.4	2.5	1.7	2.0	70	90	120	145
20	25	----	----	----	----	1.5	2.5	1.2	2.0	50	90	75	145
15	20	----	----	----	----	1.4	2.5	1.1	2.0	45	90	70	145
35	40	20	24	3.6	4.5	2.8	4.0	1.9	3.0	75	135	140	230
30	35	----	----	----	----	2.7	3.5	1.8	2.5	70	115	135	200
40	50	27	30	4.5	6.0	4.0	5.5	2.8	3.5	110	160	200	315

TABLE 1.—*Estimated yields per acre of principal*

Soil	Corn				S ybeans	
	Grain		Silage			
	A	B	A	B	A	B
	Bu	*Bu*	*Tons*	*Tons*	*Bu*	*Bu*
Pope loam, terrace, 0 to 3 percent slopes	105	140	21	28	34	46
Pope loam, terrace, 3 to 10 percent slopes	105	140	21	28	34	46
Readington silt loam, 0 to 3 percent slopes	55	105	11	21		34
Readington silt loam, 3 to 8 percent slopes	55	105	11	21		34
Readington silt loam, 8 to 15 percent slopes	50	100	10	21		30
Reaville shaly silt loam, 0 to 3 percent slopes	40	75	8	15		
Reaville shaly silt loam, 3 to 8 percent slopes	40	75	8	15		
Reaville shaly silt loam, 8 to 15 percent slopes	35	75	7	15		
Rowland silt loam	95	130	19	26	30	44
Steinsburg gravelly loam, 3 to 8 percent slopes	60	85	12	17	20	28
Steinsburg gravelly loam, 8 to 15 percent slopes	55	75	11	15	18	26
Steinsburg gravelly loam, 15 to 25 percent slopes	50	70	10	14		
Towhee silt loam, 0 to 3 percent slopes						
Towhee silt loam, 3 to 8 percent slopes						
Urbana silt loam, 0 to 3 percent slopes	55	100	11	20	18	34
Urbana silt loam, 3 to 8 percent slopes	55	100	11	20	18	34
Washington gravelly silt loam, 3 to 8 percent slopes	85	135	17	27	28	46
Weikert-Culleoka shaly silt loams, 15 to 25 percent slopes						
Woodstown silt loam, 0 to 5 percent slopes	70	115	14	23	24	38

[1] Cow-acre-days is a term used to express the carrying capacity of pasture. It is the number of animal units carried per acre multiplied by the number of days the pasture is grazed during a single grazing season without injury to the sod. An animal unit is 1 cow, steer, horse

seedlings and saplings, 12 percent. The remaining 7 percent is classified nonstocked.

In general the soils in this county are capable of supporting a good growth of yellow-poplar, ash, red oak, and sugar maple. Trees grow slowly on shallow soils and on poorly drained soils.

A landowner can encourage growth of desirable kinds of trees by using good woodland management. The soils and the climate of Bucks and Philadelphia Counties are favorable, and help in planning a program of woodland improvement can be obtained from local technicians.

The returns from soils that are excellent, very good, and good growing sites generally justify the expenditure of money for management purposes. The potential yield, market potential, and quality of the particular species growing on the site have to be considered. The proportion of poor quality stems or species growing on such sites may prohibit investment for management purposes. Also, the conversion of such areas from their present state to their potential capacity may not be economically justifiable.

Soils that are only fair growing sites are the most difficult to appraise for management. A thorough appraisal of the species, quality, and marketability of trees on the site is essential. A proper analysis of all of these interrelated factors is essential in determining the intensity of management.

The returns from poor growing sites generally will not economically justify management for the production of wood products. In many areas, however, woodland is the most practical use for soils that do not show a profitable return from crops or pasture.

Seventy percent of the trees in the county are growing on soils that are excellent, very good, and good woodland sites; 15 percent are on fair sites, and 15 percent are on poor sites.

Table 2 rates each soil according to management problems and hazards, lists suitable tree species, and rates site quality for producing timber.

Erosion hazard refers to the degree of potential soil erosion. The ratings indicate the amount or intensity of management required to reduce or control erosion on the different soils. A rating of *slight* indicates that the risk of erosion is low when wood products are harvested, and that few, if any, erosion control measures are needed. A rating of *moderate* indicates that erosion control is needed on skid and logging roads immediately after wood products are harvested. A rating of *severe* means that intensive management is needed to control erosion, especially gullying, where wood products are harvested. Harvesting and logging should be done across the slope as much as possible. Skid trails and roads should be laid out on as low grades as possible, and water-disposal system should be carefully maintained during logging. Erosion control measures are needed on roads and skid trails immediately after logging.

Equipment limitations refers to characteristics of the soils and topographic features that restrict or prohibit the use of equipment for harvesting trees or planting seedlings. Steep slopes, stoniness, and wetness are the principal soil limitations that restrict the use of equipment. The rating is *slight* if there are few limitations. It is *moderate* if some problems exist, such as stones and boulders on the surface, moderately steep slopes, or wet-

crops under two levels of management—Continued

Wheat		Tomatoes		Sweet corn		Hay				Pasture			
						Alfalfa-grass mixture		Grass-legume mixture		Blue grass		Tall grass	
A	B	A	B	A	B	A	B	A	B	A	B	A	B
Bu	*Bu*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]	*Cow-acre-days* [1]
40	50	27	30	3.5	6.0	4.0	5.5	2.8	3.5	110	160	200	315
40	50	27	30	4.5	6.0	4.0	5.5	2.8	3.5	110	160	200	315
30	45	17	24	2.8	4.7	2.1	3.5	1.7	3.0	70	135	105	200
30	45	17	24	2.8	4.7	2.3	3.5	1.7	3.0	70	135	115	200
25	40	--------	--------	--------	--------	2.3	3.5	1.7	3.0	70	135	115	200
--------	--------	--------	--------	--------	--------	--------	--------	1.4	2.5	55	115	70	145
--------	--------	--------	--------	--------	--------	--------	--------	1.4	2.5	55	115	70	145
--------	--------	--------	--------	--------	--------	--------	--------	1.2	2.0	50	90	60	115
30	45	24	29	4.1	5.9	3.5	4.5	2.6	3.5	105	160	175	235
30	35	17	21	2.5	4.1	2.3	3.5	1.6	3.0	65	135	115	200
30	35	--------	--------	--------	--------	2.2	3.0	1.5	2.5	60	115	110	170
25	30	--------	--------	--------	--------	2.1	3.0	1.4	2.0	55	90	105	170
--------	--------	--------	--------	--------	--------	--------	--------	1.2	2.0	--------	--------	60	115
--------	--------	--------	--------	--------	--------	--------	--------	1.2	2.0	--------	--------	60	115
30	40	17	24	2.6	4.7	2.1	3.5	1.7	3.0	70	135	105	200
30	40	17	24	2.6	4.7	2.3	3.5	1.7	3.0	70	135	115	200
45	50	26	29	4.0	5.8	3.5	5.5	2.3	3.5	90	160	175	315
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	30	60	--------	--------
30	40	22	27	3.2	4.5	2.5	4.0	2.0	3.0	80	135	125	230

or mule; 5 hogs; or 7 sheep. An acre of pasture that provides 30 days of grazing for 2 cows, for example, has a carrying capacity of 60 cow-acre-days.

ness. The rating is *severe* if prolonged wetness of the soil, steepness, or stoniness severely limit the use of equipment. If the rating is severe, track-type equipment is best for general use, and winches or similar special equipment are needed for some kinds of work.

Seedling mortality refers to the loss of naturally occurring or planted tree seedlings resulting from unfavorable characteristics of the soils. The rating is *slight* if no more than 25 percent of the planted seedlings are likely to die, and satisfactory restocking from the initial planting can be expected. Adequate restocking ordinarily results from natural regeneration. A rating of *moderate* indicates that between 25 and 50 percent of planted seedlings are likely to die, and some replanting is ordinarily needed. Natural regeneration cannot always be relied upon for adequate and early restocking. A rating of *severe* indicates that more than 50 percent of planted seedlings are likely to die, and special preparation of the seedbed, superior planting techniques, and considerable replanting are needed for adequate and immediate restocking. Restocking cannot be expected to result from natural regeneration if the rating for seedling mortality is severe.

Plant competition refers to the rate at which brush, grass, and undesirable trees are likely to invade. Plant competition is *slight* if unwanted plants do not prevent adequate natural regeneration and early growth or interfere with adequate development of planted seedlings. It is *moderate* if competing plants delay natural or artificial regeneration, both establishment and growth, but do not prevent the natural development of a fully stocked normal stand. Competition is *severe* if adequate natural or artificial regeneration can be obtained only by intensive site preparation and maintenance, including weeding.

Windthrow hazard refers to factors that control the development of tree roots and, consequently, the likelihood that trees will be uprooted by wind. A rating of *slight* means that trees are not expected to be blown down in commonly occurring winds. A rating of *moderate* indicates that some trees are expected to be blown down during periods of excessive soil wetness and high wind. A rating of *severe* means that many trees are expected to be blown down during periods of soil wetness and moderate or high winds.

Suitable species are fast-growing trees that have high economic value. Considered in the table are the kinds of trees to be favored in the management of existing stands and the kinds favorable for planting.

Site quality indicates the potential of the soils to produce timber. The ratings are based on sample plots in these and adjacent counties. Other soils in the counties that have characteristics similar to those of the soils studied were assumed to have approximately the same rating. The ratings are based on the site index, or the average height attained by the dominant and codominant trees at the age of 50 years. Foresters using this rating can determine the volume of timber that normal stands will produce at different ages.

For oak a site index of 85 or better is rated *excellent*, and the expected yield at age 50 is 13,750 or more board feet per acre (published data for oak only to site index 80, International rule) (*14*). A site index of 75 to 84 is rated *very good*, and the expected yield at age 50 is about

TABLE 2.—*Woodland*

[Alluvial land, Marsh, and Urban land are generally not

Soils and mapping symbols	Degree of limitations: Erosion hazard	Degree of limitations: Equipment limitation	Degree of limitations: Seedling mortality
Abbottstown: AbA, AbB, AbC	Slight where slope is 0 to 8 percent. Moderate where slope is more than 8 percent.	Moderate	Moderate
Allenwood: AdB, AdC, AdD	Slight where slope is 3 to 15 percent. Moderate where slope is more than 15 percent.	Slight where slope is 3 to 15 percent. Moderate where slope is more than 15 percent.	Slight
Alton: AgA, AgB, AlA	Slight	Slight	Severe
Bedington: BeA, BeB, BeC	Slight	Slight	Slight
Bowmansville: Bo	Slight	Severe	Severe
Chalfont: CaA, CaB	Slight	Moderate	Moderate
Chester: CeA, CeB, CeC, CeD, ChD	Slight where slope is 0 to 15 percent. Moderate where slope is more than 15 percent or where surface is stony.	Slight where slope is 0 to 15 percent. Moderate where slope is more than 15 percent or where surface is stony.	Slight
Clarksburg: ClB	Slight	Slight	Slight
Culleoka-Weikert: CwB, CwC	Slight	Slight	Severe
Doylestown: DoA, DoB	Slight	Severe	Severe
Duffield: DsB	Slight	Slight	Slight
Duffield and Washington: DtC	Moderate	Moderate	Slight
Duncannon: DuA, DuB	Slight	Slight	Slight
Fallsington, gravelly subsoil variant: Fa.	Slight	Severe	Severe
Hatboro: Ha	Slight	Severe	Severe
Howell: HoA, HoB	Slight	Slight	Slight
Klinesville: KlB, KlC, KlD	Slight	Slight where slope is 3 to 15 percent. Moderate where slope is more than 15 percent.	Severe
Lansdale: LaA, LaB, LaC, LaD, LdB, LdD, LdE,	Slight where slope is 0 to 15 percent. Moderate where slope is more than 15 percent.	Slight where slope is 0 to 15 percent. Moderate where slope is 15 to 25 percent or surface is extremely stony. Severe where slope is more than 25 percent.	Slight
Lawrenceville: LgA, LgB	Slight	Slight	Slight

management

suited to commercial woodland and are not listed]

Degree of limitations—Continued			Suitable species—		Quality of site
Plant competition		Windthrow hazard	To favor in existing stands	For planting or seeding	
Conifers	Hardwoods				
Severe	Moderate	Moderate	Yellow-poplar, red oak, ash, sugar maple.	Yellow-poplar, larch, Virginia pine, white pine, Norway spruce.	Good.
Moderate	Slight	Slight	Yellow-poplar, red oak, ash, sugar maple.	Yellow-poplar, larch, Virginia pine, white pine, Norway spruce.	Good.
Slight	Slight	Slight	Red maple, black oak	White pine, Virginia pine	Poor.
Severe	Moderate	Slight	Yellow-poplar, red oak, ash, sugar maple.	Yellow-poplar, larch, Norway spruce, white pine, black walnut, Virginia pine.	Very good.
Severe	Severe	Moderate	Pin oak, red maple, sycamore	White pine, white spruce	Fair.
Severe	Moderate	Moderate	Yellow-poplar, red oak, ash, sugar maple, red maple.	Yellow-poplar, white pine, white spruce, Norway spruce.	Good.
Severe	Moderate	Slight	Red oak, yellow-poplar, ash, black walnut, sugar maple, white pine.	Yellow-poplar, black walnut, larch, Norway spruce, white pine.	Very good.
Severe	Moderate	Slight	Yellow-poplar, ash, sugar maple	Yellow-poplar, larch, Norway spruce, white pine.	Very good.
Slight	Slight	Moderate	Pin oak, red maple, sycamore	White pine, white spruce	Fair.
Moderate	Moderate	Severe	Pin oak, red maple, sycamore	White pine, white spruce	Fair.
Severe	Moderate	Slight	Yellow pine, black walnut, red oak, ash, sugar maple.	Yellow pine, black walnut, larch, Norway spruce, white pine.	Excellent.
Severe	Moderate	Slight	Yellow pine, black walnut, red oak, ash, sugar maple.	Yellow pine, black walnut, larch, Norway spruce, white pine.	Excellent.
Severe	Moderate	Slight	Yellow pine, black walnut, red oak, ash, sugar maple.	Yellow pine, black walnut, larch, Norway spruce, white pine.	Very good
Moderate	Moderate	Severe	Yellow-poplar, red oak, ash, sugar maple.	Yellow-poplar, larch, Norway spruce, white spruce, white pine.	Very good.
Severe	Severe	Moderate	Pin oak, red maple, sycamore	White pine, white spruce	Fair.
Severe	Moderate	Slight	Yellow-poplar, black walnut, red oak, ash, sugar maple.	Yellow-poplar, black walnut, larch, Norway spruce, white pine.	Very good.
Slight	Slight	Slight	Red oak, black oak, chestnut oak, Virginia pine.	Virginia pine, white pine	Fair.
Moderate	Severe	Slight	Yellow-poplar, red oak, ash, sugar maple, Virginia pine.	Yellow-poplar, larch, Norway spruce, Virginia pine, white pine.	Good.
Moderate	Slight	Slight	Yellow-poplar, red oak, ash, sugar maple, Virginia pine.	Yellow-poplar, larch, Norway spruce, Virginia pine, white pine.	Good.

TABLE 2.—*Woodland*

Soils and mapping symbols	Degree of limitations: Erosion hazard	Equipment limitation	Seedling mortality
Lehigh: LhB, LhC, LlD	Slight where slope is 2 to 8 percent. Moderate where slope is 8 to 18 percent and surface is channery. Severe where surface is extremely stony.	Moderate	Moderate
Manor: MaB, MaC, MaD, MbD	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is more than 15 percent or surface is stony.	Slight where slope is 3 to 15 percent. Moderate where slope is more than 15 percent or surface is stony.	Moderate
Manor and Chester: McE	Severe	Severe	Moderate
Mount Lucas: MlA, MlB, MlC, MoB, MoD.	Slight where slope is 0 to 15 percent. Moderate where slope is 8 to 25 percent and surface is extremely stony.	Slight where surface is silt loam. Moderate where surface is extremely stony silt loam.	Slight
Neshaminy: NeB, NeC, NhB, NhD, NhE.	Slight where surface is channery or slope is 0 to 8 percent. Moderate where surface is extremely stony and slope is 8 to 25 percent. Severe where slope is more than 25 percent.	Slight where surface is channery. Moderate where surface is extremely stony and slope is 0 to 25 percent. Severe where slope is more than 25 percent.	Slight
Penn: PeA, PeB, PeC, PeD	Slight where slope is 0 to 15 percent. Moderate where slope is more than 15 percent.	Slight where slope is 0 to 15 percent. Moderate where slope is more than 15 percent.	Moderate
Penn-Klinesville:			
PhB3, PkC3	Slight	Slight	Severe
PlD, PlE	Slight where slope is 8 to 25 percent. Moderate where slope is more than 25 percent.	Moderate where slope is 8 to 25 percent. Severe where slope is more than 25 percent.	Severe
Penn-Lansdale: PnB, PnC	Slight	Slight	Moderate
Pope: PoA, PpA, PpB	Slight	Slight	Slight
Readington: RdA, RdB, RdC	Slight where slope is 0 to 8 percent. Moderate where slope is more than 8 percent.	Slight	Slight
Reaville: ReA, ReB, ReC	Slight where slope is 0 to 8 percent. Moderate where slope is more than 8 percent.	Severe	Severe
Rowland: Ro	Slight	Slight	Slight
Steinsburg: StB, StC, StD	Slight	Slight where slope is 3 to 15 percent. Moderate where slope is more than 15 percent.	Moderate
Towhee: ToA, ToB, TwB	Slight	Severe	Severe

management—Continued

Degree of limitations—Continued			Suitable species—		Quality of site
Plant competition		Windthrow hazard	To favor in existing stands	For planting or seeding	
Conifers	Hardwoods				
Severe	Moderate	Moderate	Yellow-poplar, red oak, ash, sugar maple, red maple.	Yellow-poplar, larch, Norway spruce, white pine.	Good.
Severe	Moderate	Slight	Yellow-poplar, red oak, Virginia pine, ash.	Yellow-poplar, larch, Virginia pine, Norway spruce, white pine.	Very good.
Severe	Moderate	Slight	Yellow-poplar, red oak, Virginia pine, ash.	Yellow-poplar, larch, Virginia pine, Norway spruce, white pine.	Very good.
Severe	Moderate	Slight	Yellow-poplar, red oak, ash, sugar maple, Virginia pine.	Yellow-poplar, larch, Virginia pine, Norway spruce, white spruce, white pine.	Very good.
Severe	Moderate	Slight	Yellow-poplar, black walnut, ash, sugar maple, red oak.	Yellow-poplar, black walnut, larch, Virginia pine, Norway spruce, white pine.	Very good.
Moderate	Slight	Slight	Yellow-poplar, red oak, black oak, Virginia pine.	Yellow-poplar, Virginia pine, larch, Norway spruce, white pine.	Good.
Slight	Slight	Moderate	Black oak, chestnut oak, Virginia pine.	Virginia pine, white pine, pitch pine.	Poor.
Slight	Slight	Moderate	Black oak, chestnut oak, Virginia pine.	Virginia pine, white pine, pitch pine.	Poor.
Moderate	Slight	Slight	Yellow-poplar, red oak, black oak, Virginia pine.	Yellow-poplar, Virginia pine, larch, Norway spruce, white pine.	Good.
Severe	Moderate	Slight	Yellow-poplar, black walnut, red oak, ash, sugar maple.	Yellow-poplar, black walnut, larch, Norway spruce, white pine.	Very good.
Moderate	Slight	Slight	Yellow-poplar, red oak, ash, sugar maple.	Yellow-poplar, larch, Norway spruce, white pine.	Good.
Moderate	Moderate	Severe	Red oak, black oak, red maple, Virginia pine.	Virginia pine, white pine	Fair.
Severe	Moderate	Slight	Yellow-poplar, black walnut, red oak, ash, sugar maple.	Yellow-poplar, black walnut, larch, Norway spruce, white pine.	Very good.
Moderate	Slight	Slight	Red oak, black oak, ash, Virginia pine.	White pine, Virginia pine	Good.
Moderate	Moderate	Severe	Yellow-poplar, red oak, ash, sugar maple.	Yellow-poplar, white pine, white spruce.	Good.

TABLE 2.—*Woodland*

Soils and mapping symbols	Degree of limitations		
	Erosion hazard	Equipment limitation	Seedling mortality
Urbana: UrA, UrB	Slight	Slight	Slight
Washington: WaB	Slight	Slight	Slight
Weikert-Culleoka: WcD	Slight	Moderate	Severe
Woodstown: WoA	Slight	Moderate	Slight

13,750 board feet per acre. A site index of 65 to 74 is rated *good*, and the expected yield at age 50 is about 9,750 board feet per acre. A site index of 55 to 64 is rated *fair*, and the expected yield at age 50 is about 6,300 board feet per acre. A site index of less than 54 is rated *poor*, and the expected yield at age 50 is less than 3,250 board feet per acre.

For yellow-poplar an excellent site has a site index of 95 or better, and the expected yield at age 50 is 32,150 board feet per acre (*4, 9*). A site index of 85 to 95 is rated *very good*, and the expected yield at age 50 is about 24,000 board feet per acre. A site index of 75 to 85 is *good*, and the expected yield is 17,620 board feet per acre. A site index of 65 to 75 is *fair*, and the expected yield is 11,400 board feet per acre. A site index of 55 to 65 is *poor* and the expected yield is 5,600 board feet per acre.

The site index for other trees, such as white pine, sugar maple, ash, and black cherry, varies somewhat. The better sites support the trees of species that are tallest at the age of 50 years. As the site quality decreases, the height of the trees decreases accordingly. More information on site index for other tree species can be obtained from the United States Department of Agriculture, Soil Conservation Service, and from the Bureau of Forests, Pennsylvania Department of Environmental Resources.

Use of the Soils for Wildlife

The kinds and amounts of wildlife in Bucks and Philadelphia Counties depend on the kinds of soils. The relationships, however, are not always easily distinguished. Soils affect wildlife through their influence on the vegetation that grows and supplies food and cover for the wildlife.

Under natural conditions, the distribution of the various kinds of soils in an area depends on the patterns or combinations of vegetation. An area is inhabited by the kinds of wildlife that have their habitat requirements met by the vegetation in the area. If the natural conditions in the area are altered by drainage, or by the other practices used in managing farms or woodland, the kinds and patterns of vegetation change and, in turn, the kinds and numbers of wildlife.

[4] By CLAYTON L. HEINEY, wildlife biologist, Soil Conservation Service.

Kinds of wildlife

Information in the following paragraphs relates only to the distribution and abundance of wildlife in Bucks County.

White-tailed deer are considered forest species, but they neither prefer nor do well in large mature forests. They prefer a combination of brush or young trees, lesser amounts of mature trees, and small open areas. Deer can be found in woodlots throughout Bucks County. The largest concentrations occur in the northeast corner of the county along the Delaware River in Tinicum, Haycock, Nockamixon, Bridgeton, and Durham townships. The deer population generally declines south and west of these townships. It is high, however, along the river in the Solebury and Jericho Mountain area. The distribution and abundance of deer do not appear to relate to the kinds of soil, but the larger deer are associated with the more fertile soils in the Lansdale-Lawrenceville and the Duffield-Washington soil associations.

Gray squirrels and cottontail rabbits are found throughout the county. The concentrations of squirrels appear to coincide with the deer population, especially in mature woodland. The largest populations of cottontails seem to be in the northern part of Bucks County on the Towhee-Neshaminy-Mount Lucas and the Chester soil associations. This is marginal farmland that is growing up into brush. Lower Makefield, Falls, and Bristol Townships in the southern end of the county also have a high rabbit population. The populations here coincide with areas of active farming.

Pheasant and doves are abundant on farms. They are most numerous in the southern part of the county, but no correlation seems to exist with soils. High densities in the north seem to be correlated with the Abbottstown-Doylestown-Reaville soil association.

management—Continued

Degree of limitations—Continued			Suitable species—		Quality of site
Plant competition		Windthrow hazard	To favor in existing stands	For planting or seeding	
Conifers	Hardwoods				
Severe	Moderate	Slight	Yellow-poplar, red oak, ash, sugar maple, red maple, white pine.	Yellow-poplar, larch, Norway spruce, white pine.	Very good.
Severe	Moderate	Slight	Yellow-poplar, black walnut, red oak, ash, sugar maple.	Yellow-poplar, larch, Norway spruce, white pine.	Excellent.
Slight	Slight	Moderate	Red oak, black oak, chestnut oak, Virginia pine.	Virginia pine, white pine, pitch pine.	Fair.
Severe	Moderate	Slight	Yellow-poplar, red oak, ash, sugar maple.	Yellow-poplar, larch, Norway spruce, white pine.	Very good.

Waterfowl, mainly mallards, wood ducks, black ducks, and teal, can be found in fair numbers on the lower part of the Delaware River, and in lesser numbers on the upper Delaware River, Brush Meadows, Tohickon Creek, and the Pennsylvania Canal. Canada geese are the most abundant waterfowl. They are primarily resident birds that utilize farm ponds except during the coldest part of the winter.

Small populations of grouse and woodcock inhabit the county. The grouse are on the Towhee-Neshaminy-Mount Lucas soil association, and the woodcock are on moist, well-drained soils along most waterways.

Soil suitability for wildlife

In table 3, the soils are rated according to their suitability for six types of wildlife food and cover, two types of water developments, and three kinds of wildlife (*1*). These wildlife habitat elements are described in the following paragraphs.

Grain and seed crops are domestic grains or seed-producing annual herbaceous plants that are planted to produce food for wildlife. Examples are corn, sorghum, wheat, millet, buckwheat, soybeans, and sunflower.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted to furnish food and cover for wildlife. Examples are fescue, brome, bluegrass, timothy, redtop, orchardgrass, reed canarygrass, clover, trefoil, alfalfa, and sericea lespedeza.

Wild herbaceous upland plants are native or introduced perennial grasses or forbs that generally are established naturally and that provide food and cover mainly for upland wildlife. Examples are ragweed, wheatgrass, wildrye, catgrass, pokeweed, strawberries, beggarweed, goldenrod, and dandelion.

Hardwood woody plants are deciduous trees, shrubs, and woody vines that produce fruit, nuts, buds, catkins, twigs, or foliage that are used extensively as food by wildlife and that commonly are established naturally but also may be planted. Examples are oak, beech, cherry, hawthorn, dogwood, viburnums, holly, maple, birch, and poplar. Smaller plants include grape, honeysuckle, blueberry, briers, greenbrier, raspberry, and roses.

Coniferous woody plants are cone-bearing trees and shrubs that are important to wildlife primarily as cover but also furnish food in the form of browse, seeds, or cones. These trees and shrubs are commonly established naturally, but they also may be planted. Examples are pine, spruce, white-cedar, hemlock, fir, redcedar, juniper, and yew.

Wet food and cover plants are annual and perennial grasses and grasslike plants on moist to wet sites, excluding submerged or floating aquatic plants that produce the food and cover used mainly by wetland wildlife. Examples of wetland food plants are smartweed, wild millet, bulrushes, sedges, wild rice, switchgrass, reed canarygrass, and cattails.

Shallow water developments are areas of water that have been made by building low dikes or levees, by digging shallow excavations, or by using devices to control the water of marshy streams or channels.

Excavated ponds are dugout areas or a combination of dugout areas and low dikes that hold water of suitable quality, suitable depth, and in ample supply for the production of fish or wildlife. Such a pond should have a surface area of at least one-quarter acre and an average depth of 6 feet or more in at least a quarter of the area. Also required is a water table that is permanently high or another source of unpolluted water of low acidity.

Openland wildlife are the birds and mammals commonly found in crop fields, in meadows and pastures, and on nonforested, overgrown land. Among these birds and mammals are quail, ring-necked pheasant, mourning doves, woodcock, cottontail rabbit, meadowlarks, killdeer, and field sparrows.

Woodland wildlife are birds and mammals commonly found in wooded areas. Examples are ruffed grouse, wild turkey, wood thrushes, warblers, vireos, deer, squirrel, and raccoon.

Wetland wildlife are birds and mammals commonly found in marshes and swamps. Examples are ducks, geese, heron, snipe, rails, coots, muskrat, mink, and beaver.

TABLE 3.—*Suitability of soils for elements*

[The land types Alluvial land, Urban land, and the Urban land

Soils and map symbols	Wildlife habitat elements				
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants
Abbottstown:					
AbA	Suited	Suited	Well suited	Well suited	Well suited
AbB	Suited	Suited	Well suited	Well suited	Well suited
AbC	Suited	Suited	Well suited	Well suited	Well suited
Allenwood:					
AdB, AdC	Suited	Well suited	Well suited	Well suited	Well suited
AdD	Poorly suited	Suited	Well suited	Well suited	Well suited
Alton: AgA, AgB, AlA	Poorly suited	Suited	Suited	Poorly suited	Poorly suited
Bedington:					
BeA	Well suited	Well suited	Well suited	Well suited	Well suited
BeB, BeC	Suited	Well suited	Well suited	Well suited	Well suited
Bowmansville: Bo	Poorly suited	Suited	Suited	Suited	Suited
Chalfont:					
CaA	Suited	Suited	Well suited	Well suited	Well suited
CaB	Suited	Suited	Well suited	Well suited	Well suited
Chester:					
CeA	Well suited	Well suited	Well suited	Well suited	Well suited
CeB, CeC	Suited	Well suited	Well suited	Well suited	Well suited
CeD	Poorly suited	Suited	Well suited	Well suited	Well suited
ChD	Not suited	Poorly suited	Poorly suited	Suited	Suited
Clarksburg: ClB	Suited	Well suited	Well suited	Well suited	Well suited
Culleoka-Weikert: CwB, CwC	Not suited	Poorly suited	Poorly suited	Not suited	Not suited
Doylestown:					
DoA	Poorly suited	Suited	Suited	Suited	Suited
DoB	Poorly suited	Suited	Suited	Suited	Suited
Duffield: DsB	Suited	Well suited	Well suited	Well suited	Well suited
Duffield and Washington: DtC	Suited	Well suited	Well suited	Well suited	Well suited
Duncannon:					
DuA	Well suited	Well suited	Well suited	Well suited	Well suited
DuB	Suited	Well suited	Well suited	Well suited	Well suited
Fallsington gravelly subsoil variant: Fa.	Poorly suited	Suited	Suited	Suited	Suited
Hatboro: Ha	Poorly suited	Suited	Suited	Suited	Suited
Howell:					
HoA	Well suited	Well suited	Well suited	Well suited	Well suited
HoB	Suited	Well suited	Well suited	Well suited	Well suited
Klinesville: KlB, KlC, KlD	Not suited	Poorly suited	Poorly suited	Not suited	Not suited
Lansdale:					
LaA	Well suited	Well suited	Well suited	Well suited	Well suited
LaB, LaC	Suited	Well suited	Well suited	Well suited	Well suited
LaD	Poorly suited	Suited	Well suited	Well suited	Well suited
LdB, LdD, LdE	Not suited	Not suited	Poorly suited	Poorly suited	Poorly suited
Lawrenceville:					
LgA	Well suited	Well suited	Well suited	Well suited	Well suited
LgB	Suited	Well suited	Well suited	Well suited	Well suited

of wildlife habitat and for kinds of wildlife

complexes are not listed because they are too variable to be rated]

Wildlife habitat elements—Continued			Kinds of wildlife		
Wet food and cover plants	Shallow water developments	Excavated ponds	Openland	Woodland	Wetland
Suited	Suited	Suited	Well suited	Well suited	Suited.
Poorly suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Poorly suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Suited	Suited	Poorly suited	Suited	Suited.
Suited	Suited	Suited	Well suited	Well suited	Suited.
Poorly suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Not suited	Not suited.
Well suited	Well suited	Poorly suited	Suited	Suited	Well suited.
Poorly suited	Not suited	Not suited	Suited	Suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Well suited	Suited	Suited	Suited	Suited	Well suited.
Poorly suited	Suited	Suited	Poorly suited	Suited	Suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Not suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Not suited	Poorly suited	Not suited.
Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.

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TABLE 3.—*Suitability of soils for elements*

Soils and map symbols	Wildlife habitat elements				
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants
Lehigh:					
LhB, LhC	Suited	Well suited	Well suited	Well suited	Well suited
LlD	Not suited	Not suited	Poorly suited	Suited	Suited
Manor:					
MaB, MaC	Suited	Well suited	Well suited	Well suited	Well suited
MaD	Poorly suited	Suited	Well suited	Well suited	Well suited
MbD	Not suited	Not suited	Poorly suited	Poorly suited	Poorly suited
Manor and Chester: McE	Not suited	Not suited	Poorly suited	Poorly suited	Poorly suited
Marsh: Mh	Not suited	Not suited	Not suited	Not suited	Not suited
Mount Lucas:					
MlA	Well suited	Well suited	Well suited	Well suited	Well suited
MlB, MlC	Suited	Well suited	Well suited	Well suited	Well suited
MoB, MoD	Not suited	Not suited	Poorly suited	Suited	Suited
Neshaminy:					
NeB, NeC	Suited	Well suited	Well suited	Well suited	Well suited
NhB, NhD, NhE	Not suited	Not suited	Poorly suited	Poorly suited	Poorly suited
Penn:					
PeA, PeB, PeC	Suited	Well suited	Well suited	Well suited	Well suited
PeD	Poorly suited	Suited	Well suited	Well suited	Well suited
Penn-Klinesville: PhB3, PkC3, PlD, PlE	Not suited	Poorly suited	Poorly suited	Not suited	Not suited
Penn-Lansdale: PnB, PnC	Suited	Well suited	Well suited	Well suited	Well suited
Pope:					
PoA, PpB	Suited	Well suited	Well suited	Well suited	Well suited
PpA	Well suited	Well suited	Well suited	Well suited	Well suited
Readington:					
RdA	Well suited	Well suited	Well suited	Well suited	Well suited
RdB, RdC	Suited	Well suited	Well suited	Well suited	Well suited
Reaville:					
ReA	Suited	Suited	Well suited	Suited	Suited
ReB, ReC	Suited	Suited	Well suited	Suited	Suited
Rowland: Ro	Suited	Well suited	Well suited	Well suited	Well suited
Steinsburg:					
StB, StC	Suited	Well suited	Well suited	Suited	Suited
StD	Poorly suited	Suited	Well suited	Suited	Suited
Towhee:					
ToA	Poorly suited	Suited	Suited	Suited	Suited
ToB	Poorly suited	Suited	Suited	Suited	Suited
TwB	Not suited	Not suited	Poorly suited	Poorly suited	Poorly suited
Urbana:					
UrA	Well suited	Well suited	Well suited	Well suited	Well suited
UrB	Suited	Well suited	Well suited	Well suited	Well suited
Washington: WaB	Well suited	Well suited	Well suited	Well suited	Well suited
Weikert-Culleoka: WcD	Not suited	Poorly suited	Poorly suited	Not suited	Not suited
Woodstown: WoA	Well suited	Well suited	Well suited	Well suited	Well suited

of wildlife habitat and for kinds of wildlife—Continued

Wildlife habitat elements—Continued			Kinds of wildlife		
Wet food and cover plants	Shallow water developments	Excavated ponds	Openland	Woodland	Wetland
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Not suited	Suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Not suited	Poorly suited	Not suited.
Not suited	Not suited	Not suited	Not suited	Poorly suited	Not suited.
Well suited	Well suited	Well suited	Not suited	Not suited	Well suited.
Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Not suited	Suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Not suited	Poorly suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Not suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Suited	Suited	Not suited	Suited	Suited	Suited.
Suited	Not suited	Not suited	Suited	Suited	Not suited.
Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Suited.
Not suited	Not suited	Not suited	Well suited	Suited	Not suited.
Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Suited	Not suited	Not suited	Suited	Suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Poorly suited	Not suited.
Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Not suited	Not suited.
Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Suited.

Each rating under "Kinds of wildlife" in table 3 is based on the ratings listed for the habitat elements in the first part of the table. For openland wildlife the rating is based on the ratings shown for grain and seed crops, grasses and legumes, wild herbaceous upland plants, hardwood woody plants, and coniferous woody plants. The rating for woodland wildlife is based on the ratings listed for grasses and legumes, wild herbaceous upland plants, hardwood woody plants, and coniferous woody plants. For wetland wildlife the rating is based on the ratings shown for wetland food and cover plants, shallow water developments, and excavated ponds.

All soils in the area are suitable for producing some kind of habitat for wildlife. The soils in capability classes I, II, III, and IV are generally more valuable for crops than for wildlife, but wildlife may be plentiful and a secondary crop. Soils in capability classes VI, VII, and VIII are generally used for wildlife and are better suited to wildlife and woodland than to cultivation.

Practices that are used primarily to protect and improve the soils and to increase crop production also benefit wildlife. Contour stripcropping and rotation of crops provide a mixture of cover and increase the amount of food and cover that wildlife can use. During winter, cover crops and crop residue are used by wildlife for food and cover. Diversions and grassed waterways provide travel lanes and nesting places. Food and cover for wildlife are increased by fertilization and liming.

Practices used primarily to benefit wildlife supplement the practices used primarily to maintain or increase crop yields. Plantings of grasses and legumes along field borders provide nesting places and food for wildlife. Hedgerows planted on cropland furnish travel lanes, food, and cover. They also fence the field and protect the soil to some extent. Small patches of corn, small grain, and soybeans that are planted to supply food for wildlife are particularly valuable in abandoned or idle areas, especially if these patches are located near good cover or between wooded areas and open fields.

Habitat for wetland wildlife can be made or improved by digging ponds in pastures or, for shallow water impoundments, by installing special structures for water control in marshy areas. The ponds can be stocked with fish, and they are also used by migratory waterfowl as resting places. If shrubs and trees are planted around these ponds, they attract many other kinds of wildlife. Shallow impoundments are breeding grounds and feeding areas for waterfowl and shorebirds. Muskrat, mink, and other furbearers also benefit from these developments. Because many of the soils in the area are not suitable as pond sites, sites should be selected with care before a pond is planned.

The greatest danger to fish in the waters of the area is from pollution, including that from erosion sediment. Fish are killed by industrial waste, sewage, insecticides, and herbicides, but soil erosion is particularly damaging. As sediment is washed into rivers and streams, it settles and covers spawning beds and recently hatched fish. Sediment destroys food and food-producing areas. By filling pools, sediment causes water temperature to rise to a point that is harmful to fish. Erosion of the streambanks is particularly damaging. Commonly this erosion is caused by overgrazing. The streambanks can be protected by control of grazing and by plantings. But protecting the streambank is not enough; the entire watershed should be protected by carrying out a complete plan that protects every farm and all of the land in the watershed.

Engineering Uses of the Soils [5]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 4, 5, and 6, which show, respectively, results of engineering laboratory tests on soil samples; several estimated soil properties significant to engineering; and interpretations for various engineering uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 5 and 6, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering work, especially work that involves heavy loads or that requires excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil may contain small areas of other kinds of soil that

[5] PETER PETRAS, civil engineer, Soil Conservation Service, assisted in preparation of this section.

have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning in soil science that is not known to all engineers. The Glossary defines many of the terms commonly used.

Classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system, used by Soil Conservation Service engineers, Department of Defense, and others, and the AASHO system (*2*), adopted by the American Association of State Highway Officials.

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter (*20*). Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML–CL.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A–1 to A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As an additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 4; the estimated classication, without group index numbers, is given in table 5 for all soils mapped in the survey area.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary.

Test data

Table 4 contains engineering test data for some of the major soil series in Bucks County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods. The soils tested represent about 38 percent of the soils of the survey area.

Moisture-density or compaction data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort is constant, the density of the compacted material increases until the optimum moisture content is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from the semisolid to a plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Soil properties significant to engineering

Several estimated soil properties significant in engineering are given in table 5. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 5.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Depth to bedrock is the distance from the surface of the soil to the upper surface of the rock layer.

Soil texture is described in table 5 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 5 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available moisture capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

TABLE 4.—*Engineering*

[Tests performed by the Pennsylvania Department of Transportation in accordance with

Soil name and location	Parent material	Report number	Depth from surface	Moisture-density data [1]	
				Maximum dry density	Optimum moisture
			Inches	*Pound per cubic foot*	*Percent*
Bedington silt loam: 3 miles south of Doylestown and 1,000 feet south of Almshouse Road. (Modal)	Triassic shale of the Lockatong Formation.	68-21377 68-21378	13-25 38-51	107 101	18 22
Bowmansville silt loam: 40 feet northeast of Limekiln Road and 50 feet southeast of Pine Run Creek. (Modal)	Alluvium.	70-27341 70-27342	12-18 31-50	102 108	19 16
Chalfont silt loam: 700 feet northeast of Pebble Hill Road and 1 mile east of Edison. (Modal)	Silty windblown deposits over Triassic shale and sandstone of the Lockatong Formation.	68-21371 68-21372	21-27 47-57	110 111	16 17
Doylestown silt loam: 3 miles south of Doylestown and 730 feet southeast of Turk Road. (Modal)	Silty windblown deposits over Triassic shale and sandstone of the Lockatong Formation.	68-21375 68-21376	20-25 38-45	112 109	16 17
Duncannon silt loam: 3.5 miles east of Newtown and 0.5 mile north of Mount Eyre Road. (Modal)	Silty windblown deposits over Triassic shale and sandstone of the Lockatong Formation.	68-21369 68-21370	24-34 45-56	107 108	17 16
Lansdale loam: 0.5 mile southeast of Peters Corner on the northeast side of Aquetong Road. (Modal)	Triassic shale and sandstone of the Stockton Formation.	70-27332 70-27333	12-23 36-60	117 119	13 13
Lawrenceville silt loam: 1.5 miles southeast of Newtown and 550 feet south of Toll Gate Road in Core Creek Park. (Modal)	Silty windblown deposits over Triassic shale and sandstone of the Stockton Formation.	68-21365 68-21366	25-34 57-72	110 108	16 16
Neshaminy channery silt loam: 1.5 miles west of Keelersville and 0.5 mile northwest of Three Mile Run Creek. (Modal)	Diabase of Triassic age.	A-49149 A-49150	18-39 54-95	99 89	22 29
Penn silt loam: 2 miles southwest of Newtown and 50 feet east of St. Leonard Road. (Modal)	Triassic shale and sandstone of the Stockton Formation.	70-27328 70-27329	6-20 27-35	112 110	16 17
Pope loam: 0.5 mile north of Erwinna and 0.25 mile west of River Road in Tinicum Park. (Modal)	Alluvium.	68-21361 68-21362	27-37 49-61	116 115	11 13
Readington silt loam: 2 miles west of Pipersville and 50 feet south of Bedminster Road. (Modal)	Triassic shale siltstone, and sandstone of the Brunswick Formation.	70-27318 70-27319	8-24 34-50	117 119	14 14
Steinsburg gravelly loam: 2.5 miles southeast of Doylestown Borough on southeast side of County Road 350. (Modal)	Arkosic sandstone and conglomerate of the Stockton Formation.	70-27326 70-27327	8-15 15-30	127 128	10 10
Towhee silt loam: 2 miles east of Applebachville in State game lands and 0.6 mile east of intersection of Mill Road and unimproved game land road. (Modal)	Diabase of Triassic age.	68-21383 68-21384	11-21 69-76	109 110	17 18

[1] Based on "Moisture-density Relations of Soils Using 5.5-lb. Rammer and 12-in. Drop," AASHO Designation T 99-57 Method A (*2*).

[2] Mechanical analyses according to the AASHO Designation T 88-57 (*2*). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method

test data

standard procedures of the American Association of State Highway Officials (AASHO)]

Mechanical analysis [2]										Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than [3]—						AASHO	Unified
3 in	¾ in	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm				
										Percent			
--------	100	98	96	94	92	87	59	33	23	36	11	A-6(8)	ML-CL
100	93	78	68	59	51	47	33	23	15	40	10	A-4(3)	ML
--------	--------	--------	--------	100	96	92	70	38	23	37	9	A-4(8)	ML
--------	--------	--------	100	99	84	72	39	19	13	24	2	A-4(8)	ML
100	99	96	94	93	92	85	48	19	13	28	3	A-4(8)	ML
100	78	67	61	56	54	48	34	23	17	34	11	A-6(4)	ML-CL
--------	--------	100	99	97	94	90	55	28	19	30	7	A-4(8)	ML-CL
--------	--------	--------	--------	100	99	99	53	21	13	28	4	A-4(8)	ML
--------	100	98	96	94	91	86	44	15	12	28	4	A-4(8)	ML
100	99	89	81	74	70	62	35	13	9	29	2	A-4(7)	ML
--------	100	98	96	83	51	45	31	20	15	26	5	A-4(3)	ML-CL
--------	100	99	97	78	39	31	18	13	9	NP	NP	A-4(0)	SM
--------	--------	--------	100	99	97	88	56	29	20	31	6	A-4(8)	ML
--------	--------	--------	100	98	93	83	44	12	6	25	1	A-4(8)	ML
100	93	92	92	86	75	68	56	36	28	45	15	A-7-5(11)	ML
--------	--------	100	99	95	78	70	51	30	21	52	12	A-7-5(11)	MH
100	98	88	83	77	62	53	36	20	12	26	1	A-4(5)	ML
100	89	77	71	64	51	47	32	19	13	32	4	A-4(3)	ML
--------	--------	--------	--------	100	45	30	13	6	3	NP	NP	A-4(2)	SM
100	62	40	35	25	3	1	0	0	0	NP	NP	A-1-a(0)	GP
--------	100	96	91	84	78	71	46	22	16	26	5	A-4(8)	ML-CL
100	70	54	50	44	40	36	27	15	12	26	6	A-4(1)	GM-GC
100	86	84	76	43	21	18	12	9	8	24	3	A-1-b(0)	SM
--------	100	93	76	32	15	12	6	6	5	24	NP	A-1-b(0)	SM
--------	--------	--------	100	99	96	92	66	39	31	41	19	A-7-6(12)	CL
--------	--------	100	99	60	39	32	20	9	5	38	4	A-4(1)	SM

and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

[3] Classification based on material smaller than 3 inches; particles larger than 3 inches were discarded.

[4] Nonplastic.

TABLE 5.—*Estimates of soil properties*

'An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil which may appear in the first column. The symbol > means more than; the

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Bedrock	Depth from surface (typical profile)	Classification: USDA texture (typical profile)	Classification: Unified	Classification: AASHO	Coarse fraction greater than 3 inches
	Feet	*Feet*	*Inches*				*Percent*
Abbottstown: AbA, AbB, AbC	½–1½	3½–5	0–15	Silt loam	ML	A–4	0
			15–42	Silt loam, shaly silt loam, and shaly clay loam.	ML–CL, CL	A–4, A–6	0–5
			42–46	Very shaly silty clay loam	GM, GC	A–1, A–2	0–5
Allenwood: AdB, AdC, AdD	>4	3½–10	0–11	Gravelly silt loam	ML, GM	A–4	0–10
			11–46	Gravelly silty clay loam	ML, CL, GM	A–4, A–6, A–7	0–10
			46–50	Very gravelly silt loam	SM, GC, GM	A–1, A–2	5–20
Alluvial land: Ae. Properties are too variable to estimate.							
Alton: AgA, AgB, AlA	>5	4–100	0–8	Gravelly loam	SM, GM	A–2, A–4	5–15
			8–32	Very gravelly sandy loam, very gravelly loamy sand.	SM, SC	A–2	5–10
			32–60	Stratified sand and gravel	GW, GP, SP, GP–GM	A–1, A–2	5–20
Bedington: BeA, BeB, BeC	>4	4–7	0–13	Silt loam	ML, ML–CL	A–4	--------
			13–51	Silt loam, shaly silt loam	ML, CL	A–4, A–6	--------
			51–70	Very shaly silt loam, very shaly loam.	GM or GC	A–2	0–5
Bowmansville: Bo	0–1½	3½–12	0–8	Silt loam	ML	A–4	--------
			8–31	Silt loam	ML, ML–CL	A–4, A–6	--------
			31–50	Silt loam	ML, CL	A–4, A–6	--------
Chalfont: CaA, CaB	½–1½	4–8	0–14	Silt loam	ML	A–4	--------
			14–33	Silt loam, silty clay loam	ML, CL	A–4, A–6	--------
			33–60	Shaly silt loam	ML, GM, CL	A–4, A–6	0–5
Chester: CeA, CeB, CeC, CeD, ChD.	>4	5–10	0–12	Loam	ML	A–4	--------
			12–45	Channery loam to channery clay loam.	ML, CL, SM, SC	A–4, A–5, A–6	--------
			45–60	Channery loam	SM, ML	A–2, A–4, A–5	--------
Clarksburg: ClB	1½–3	5	0–10	Silt loam	ML	A–4	--------
			10–32	Clay loam	ML, CL	A–4, A–6, A–7	--------
			32–60	Silty clay loam, silt loam	ML, CL	A–4, A–6, A–7	--------
*Culleoka: CwB, CwC. For Weikert part, see Weikert series.	>3	2–3½	0–8	Shaly silt loam	GM, GC, ML	A–2, A–4, A–6	0–20
			8–24	Shaly silt loam to shaly silty clay loam.	GM, GC, SM	A–1, A–2, A–4	0–30
			24–28	Very shaly silty clay loam to very shaly silt loam.	GM, GC, SM	A–1, A–2	0–40
			28	Argillite shale bedrock.			

significant in engineering

have different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that symbol < means less than. Absence of data means no estimate was made]

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Optimum moisture	Maximum dry density	Shrink-swell potential	Corrosion potential for—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Pounds per cubic foot*			
95–100	90–100	75–95	55–85	0. 63–2. 00	0. 18–0. 20	4. 5–6. 0	-------	---------	Low-------	High-------	Moderate.
85–100	75–100	60–95	55–85	<0. 20	0. 08–0. 12	5. 1–6. 0	13–16	112–120	Low-------	High-------	Moderate.
20–50	10–40	5–40	5–35	<0. 20	0. 02–0. 06	5. 1–6. 1	11–15	115–122	Low-------	High-------	Moderate.
60–85	55–85	50–85	40–80	2. 00–6. 30	0. 12–0. 16	5. 1–6. 5	-------	---------	Low-------	Moderate---	Moderate.
60–85	55–85	50–85	40–80	0. 63–2. 00	0. 10–0. 15	4. 5–6. 0	14–22	105–118	Moderate---	Moderate---	Moderate.
60–75	50–65	40–60	20–35	0. 63–2. 00	0. 10–0. 15	4. 5–5. 0	12–17	112–122	Low-------	Moderate---	High.
55–90	50–70	25–70	15–50	2. 00–6. 30	0. 10–0. 14	5. 1–6. 0	-------	---------	Low-------	Low-------	Moderate.
50–80	40–60	25–40	15–35	>6. 30	0. 15–0. 10	5. 1–6. 0	10–14	114–126	Low-------	Low-------	Moderate.
40–55	30–55	10–40	0–15	>6. 30	0. 02–0. 06	5. 1–6. 0	8–12	118–130	Low-------	Low-------	Moderate.
100	90–100	85–95	60–85	0. 63–2. 00	0. 16–0. 20	4. 5–6. 0	-------	---------	Low-------	Low-------	Moderate.
75–100	65–95	60–95	50–95	0. 63–2. 00	0. 12–0. 18	5. 1–7. 3	14–22	101–116	Moderate---	Moderate---	Moderate.
30–55	20–50	20–45	15–35	0. 63–2. 00	0. 06–0. 10	4. 5–5. 5	12–16	110–120	Low-------	Moderate---	High.
95–100	95–100	90–100	85–100	0. 63–2. 00	0. 18–0. 20	5. 1–6. 5	-------	---------	Low-------	High-------	Moderate.
95–100	95–100	90–100	85–100	0. 20–0. 63	0. 16–0. 20	5. 1–6. 5	12–18	105–110	Low-------	High-------	Moderate.
95–100	95–100	90–100	80–100	0. 20–0. 63	0. 16–0. 20	5. 1–6. 5	8–12	115–125	Low-------	High-------	Moderate.
95–100	95–100	95–100	85–95	0. 63–2. 00	0. 18–0. 20	5. 1–6. 5	-------	---------	Low-------	Moderate---	Moderate.
95–100	90–100	90–100	85–95	<0. 20	0. 10–0. 14	5. 1–7. 3	14–18	108–112	Low-------	Moderate---	High.
50–100	45–95	45–95	40–90	0. 20–0. 63	0. 08–0. 12	5. 6–7. 3	12–17	108–115	Low-------	Moderate---	Moderate.
90–100	90–100	75–90	55–75	0. 63–2. 00	0. 12–0. 16	5. 1–7. 3	-------	---------	Low-------	Moderate---	Moderate.
85–100	75–100	65–95	40–70	0. 63–2. 00	0. 10–0. 14	5. 1–6. 0	13–19	108–115	Low-------	Low-------	Moderate.
80–100	70–100	70–95	30–55	0. 63–6. 30	0. 08–0. 12	4. 5–5. 5	12–19	110–120	Low-------	Low-------	Moderate.
95–100	90–100	80–95	75–90	0. 63–2. 00	0. 16–0. 20	5. 6–7. 3	-------	---------	Low-------	Moderate---	Moderate.
95–100	90–100	80–95	75–90	0. 20–0. 63	0. 12–0. 16	5. 1–6. 5	15–19	105–115	Moderate---	Moderate---	Moderate.
95–100	90–100	75–95	65–80	<0. 20	0. 08–0. 12	5. 6–6. 5	15–19	105–115	Moderate---	Moderate---	Moderate.
45–70	40–70	35–60	25–60	2. 00–6. 30	0. 10–0. 16	5. 6–6. 0	-------	---------	Low-------	Low-------	Moderate.
40–70	35–60	20–60	15–45	2. 00–6. 30	0. 12–0. 14	5. 1–6. 0	14–19	105–116	Low-------	Low-------	Moderate.
30–65	25–55	20–45	15–35	2. 00–6. 30	0. 02–0. 06	5. 1–6. 5	13–19	110–116	Low-------	Low-------	Moderate.

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TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Bedrock	Depth from surface (typical profile)	Classification: USDA texture (typical profile)	Classification: Unified	Classification: AASHO	Coarse fraction greater than 3 inches
	Feet	*Feet*	*Inches*				*Percent*
Doylestown: DoA, DoB	0–½	4–7	0–11	Silt loam	ML, CL	A-4, A-6	
			11–32	Silt loam, silty clay loam	ML, CL	A-4, A-6	
			32–53	Silt loam	ML, CL	A-4, A-6	
			53	Shale bedrock.			
*Duffield: DsB, DtC. For Washington part of DtC, see Washington series.	>4	4–10	0–14	Silt loam	ML, CL	A-4, A-6	
			14–45	Silty clay loam	ML, CL, MH, CH	A-4, A-6 A-7	0–10
			45–68	Channery silt loam	ML, CL, MH, CH	A-4, A-6, A-7	0–10
Duncannon: DuA, DuB	>4	>4	0–10	Silt loam	ML	A-4	
			10–45	Silt loam	ML, CL	A-4	
			45–68	Silt loam, shaly silt loam	ML, CL, GM	A-4	
Fallsington, gravelly subsoil variant: Fa.	0–½	>5	0–10	Silt loam	ML, SM	A-4, A-2	
			10–35	Gravelly silty clay loam, gravelly sandy clay loam.	SM, SC, ML, GM, GC	A-4	
			35–50	Gravelly sandy clay loam	SM, SP-SM, SC	A-2, A-4, A-6	
Hatboro: Ha	0–½	5–10	0–13	Silt loam	ML	A-4	
			13–48	Silt loam	ML, ML-CL	A-4, A-6	
			48–60	Silt loam	ML, ML-CL	A-4, A-6	
Howell: HoA, HoB	>5	>10	0–9	Silt loam	ML	A-4	
			9–42	Silty clay loam to gravelly clay loam.	CH, CL	A-6, A-7	
			42–50	Gravelly clay loam, sandy clay loam.	ML, CL	A-4, A-6	
Klinesville: KlB, KlC, KlD	>3	1–1½	0–7	Very shaly silt loam	GM, SM, SC	A-2	0–10
			7–18	Very shaly silt loam	GP-GM, GM, GP	A-1, A-2	0–10
			18	Shale bedrock.			
Lansdale: LaA, LaB, LaC, LaD, LdB, LdD, LdE.	>3	4–7	0–12	Loam	ML, SM	A-2, A-4	
			12–36	Loam, channery fine sandy loam	ML-CL, SM	A-2, A-4	
			36–60	Channery loamy sand	SM	A-2, A-4	
Lawrenceville: LgA, LgB	1½–3	4–8	0–25	Silt loam	ML	A-4	
			25–47	Silt loam	ML, ML-CL	A-4	
			47–72	Silt loam	ML, ML-CL	A-4	
Lehigh: LhB, LhC, LlD	1–2	3½–5	0–9	Channery silt loam, silt loam	ML, GM	A-4	0–5
			9–40	Channery to very channery silty clay loam.	ML or CL, GM	A-4, A-6	0–5
			40–50	Very channery silty clay loam	ML, ML-CL, GM or GC	A-2, A-4, A-6	0–5
			50	Metamorphosed shale bedrock.			
*Manor: MaB, MaC, MaD, MbD, McE. For Chester part of McE, see Chester series.	>3	4–12	0–10	Loam	GM, SM	A-2, A-4, A-6	
			10–19	Channery loam	GM, SM	A-2, A-4, A-6	
			19–60	Channery sandy loam	GM, SM	A-2, A-4, A-6	

significant in engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Optimum moisture	Maximum dry density	Shrink-swell potential	Corrosion potential for—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Pounds per cubic foot*			
95–100	95–100	85–100	80–100	0. 20–0. 63	0. 16–0. 20	5. 1–6. 5	--------	--------	Low	High	High.
95–100	95–100	95–100	85–100	<0. 20	0. 08–0. 14	5. 1–6. 5	14–18	108–114	Low	High	High.
85–100	80–100	70–100	65–100	<0. 20	0. 08–0. 12	5. 1–6. 5	21–16	110–118	Low	High	High.
70–100	70–100	65–95	55–90	0. 63–2. 00	0. 16–0. 22	5. 1–7. 3	--------	--------	Low	Moderate	Moderate.
85–100	85–100	80–100	70–90	0. 63–2. 00	0. 14–0. 17	5. 6–6. 5	15–20	100–115	Moderate	Moderate	Moderate.
80–100	75–95	70–95	60–95	0. 63–2. 00	0. 14–0. 20	5. 6–6. 5	15–25	95–105	Moderate	Moderate	Moderate.
95–100	90–100	85–100	60–100	0. 63–2. 00	0. 18–0. 20	5. 1–6. 0	--------	--------	Low	Low	Moderate.
95–100	90–100	85–100	55–100	0. 63–2. 00	0. 18–0. 20	5. 1–6. 0	10–14	114–120	Moderate	Moderate	Moderate.
60–100	50–100	45–100	40–100	0. 63–2. 00	0. 10–0. 16	5. 1–6. 5	12–16	116–122	Moderate	Moderate	High.
95–100	95–100	95–100	30–55	0. 63–2. 00	0. 14–0. 18	4. 5–5. 5	--------	--------	Low	High	High.
70–95	60–90	55–80	45–75	0. 63–2. 00	0. 05–0. 12	4. 5–5. 5	10–14	115–125	Low	High	High.
90–95	70–90	65–90	10–40	0. 63–2. 00	0. 06–0. 10	4. 5–5. 5	12–14	120–125	Low	High	High.
95–100	95–100	90–100	85–100	0. 63–2. 00	0. 16–0. 20	4. 5–5. 5	--------	--------	Low	High	High.
65–85	60–85	60–85	55–65	0. 63–2. 00	0. 16–0. 20	4. 5–5. 5	12–18	105–110	Low to moderate.	High	High.
65–85	60–85	60–85	55–65	0. 63–2. 00	0. 16–0. 20	4. 5–5. 5	12–18	105–110	Low to moderate.	High	High.
95–100	95–100	95–100	80–100	0. 63–2. 00	0. 16–0. 20	4. 0–5. 5	--------	--------	Moderate	Moderate	High.
85–100	90–100	90–100	90–100	0. 20–0. 63	0. 10–0. 14	5. 1–6. 0	18–24	91–100	Moderate	High	High.
80–100	85–100	70–90	60–80	0. 20–0. 63	0. 10–0. 14	4. 0–5. 5	16–20	100–110	Moderate	High	High.
30–70	25–55	20–50	12–35	2. 00–6. 30	0. 08–0. 12	4. 5–6. 0	--------	--------	Low	Low	High.
30–60	25–50	15–40	4–30	2. 00–6. 30	0. 04–0. 08	4. 5–6. 0	11–15	114–124	Low	Low	High.
85–100	80–100	50–85	25–70	2. 00–6. 30	0. 14–0. 18	5. 6–6. 5	--------	--------	Low	Low	Moderate.
85–100	80–100	50–85	25–65	2. 00–6. 30	0. 12–0. 16	4. 5–5. 5	10–15	110–120	Low	Low	Moderate.
60–100	50–100	30–80	15–45	2. 00–6. 30	0. 04–0. 12	4. 5–5. 5	10–14	116–124	Low	Low	High.
95–100	95–100	90–100	75–100	0. 63–6. 30	0. 18–0. 20	5. 1–6. 5	--------	--------	Low	Moderate	Moderate.
95–100	95–100	90–100	75–100	0. 20–0. 63	0. 10–0. 14	4. 5–5. 5	13–17	106–112	Low	Moderate	High.
90–100	75–100	70–100	50–100	0. 20–0. 63	0. 18–0. 20	4. 5–5. 5	14–20	100–116	Low	Moderate	High.
55–90	50–85	40–80	40–75	0. 63–2. 00	0. 16–0. 20	5. 5–7. 3	--------	--------	Low	Moderate	High.
55–90	50–85	25–80	40–75	<0. 20	0. 10–0. 16	5. 1–6. 6	15–19	100–112	Low to moderate	Moderate	High.
35–70	35–65	30–60	25–55	<0. 20	0. 02–0. 08	5. 1–6. 0	14–19	100–115	Low	Moderate	High.
55–85	45–85	35–75	30–45	2. 00–6. 30	0. 14–0. 16	4. 5–5. 5	--------	--------	Low	Low	Moderate.
55–85	45–85	35–75	30–40	2. 00–6. 30	0. 12–0. 16	5. 1–6. 0	16–18	105–118	Low	Low	Moderate.
55–85	45–85	35–75	30–40	2. 00–6. 30	0. 06–0. 10	5. 1–6. 5	10–14	110–120	Low	Low	Moderate.

TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Bedrock	Depth from surface (typical profile)	Classification: USDA texture (typical profile)	Classification: Unified	Classification: AASHO	Coarse fraction greater than 3 inches
	Feet	*Feet*	*Inches*				*Percent*
Marsh: Mh. Properties are too variable to estimate.							
Mount Lucas: MlA, MlB, MlC, MoB, MoD.	1-2	5-10	0-13	Silt loam	ML, CL	A-4, A-6	0-5
			13-46	Silty clay loam, channery silt loam.	ML, CL	A-4, A-6, A-7	0-5
			46-60	Channery silt loam	SM, SC, ML	A-2, A-4, A-6	0-5
Neshaminy: NeB, NeC, NhB, NhD, NhE.	>4	4-10	0-9	Channery silt loam	ML, CL	A-4, A-6	0-5
			9-54	Channery silty clay loam, channery clay loam.	ML, CL, SM-SC	A-4, A-6, A-7	0-10
			54-95	Sandy loam	ML, CL, MH, SM-SC	A-4, A-6, A-7	5-15
			95	Diabase bedrock.			
*Penn: PeA, PeB, PeC, PeD, PhB3, PkC3, PlD, PlE, PnB, PnC.	>4	1½-3½	0-6	Silt loam	ML, CL	A-4, A-6	--------
For Klinesville part of PhB3, PkC3, PlD, and PlE, see Klinesville series.			6-27	Shaly silt loam	ML, CL	A-4, A-6	--------
For Lansdale part of PnB and PnC, see Lansdale series.			27-35	Very shaly silt loam	GM, GC, ML	A-2, A-4	0-5
			35	Interbedded, red shale and sandstone bedrock.			
Pope: PoA, PpA, PpB	>3	>5	0-49	Loam, fine sandy loam	ML, SM, SC	A-4	--------
			49-80	Stratified sand and gravel	GM, SM, GP, SP	A-1, A-2	5-75
Readington: RdA, RdB, RdC	1½-3	3½-6	0-24	Silt loam	ML	A-4	--------
			24-50	Silty clay loam, shaly silty clay loam.	ML	A-4, A-6	--------
			50-60	Very shaly clay loam	SM, GM, GM-GC	A-2, A-4	0-15
			60	Partly weathered red shale.			
Reaville: ReA, ReB, ReC	1-2	1½-2½	0-6	Shaly silt loam	ML	A-4	0-5
			6-26	Very shaly silt loam, shaly silt loam.	ML, CL, GM, GC		0-5
			26	Partly weathered shale and siltstone bedrock.			
Rowland: Ro	1-2	3½-6	0-16	Silt loam	ML, SM	A-4	--------
			16-42	Silty clay loam	ML, SM	A-4	--------
			42-62	Fine sandy loam, loamy fine sand.	ML, GM	A-2, A-4	--------
Steinsburg: StB, StC, StD	>4	2-3½	0-8	Gravelly loam	SM, GM	A-1, A-2, A-4	0-10
			8-30	Gravelly sandy loam, sandy loam.	SM, GM, GM-GC	A-1, A-2, A-4	10-40
			30	Sandstone bedrock.			
Towhee: ToA, ToB, TwB	0-½	4-8	0-11	Silt loam	ML-CL	A-4, A-6	0-5
			11-28	Silty clay loam, gravelly silty clay loam.	ML-CH, CH, CL	A-6, A-7	0-5
			28-76	Silt loam, loam, coarse sandy loam.	ML-CL, SM	A-4, A-6	0-20

significant in engineering—Continued

Percentage passing sieve—				Perme-ability	Available water capacity	Reaction	Opti-mum mois-ture	Maximum dry density	Shrink-swell potential	Corrosion potential for—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Pounds per cubic foot*			
95–100	90–100	80–95	70–90	0. 63–2. 00	0. 16–0. 20	5. 6–6. 5	-------	---------	Low-------	Moderate---	Low.
95–100	60–100	60–100	50–85	<0. 20	0. 14–0. 16	5. 6–6. 5	17–21	104–110	Moderate---	Moderate---	Low.
80–100	60–95	55–95	30–55	<0. 20	0. 08–0. 12	5. 6–7. 3	13–18	107–118	Moderate---	Moderate---	Low.
90–100	80–100	75–95	55–80	0. 63–6. 30	0. 14–0. 18	5. 6–6. 5	-------	---------	Low-------	Low-------	Moderate.
80–100	80–100	55–95	35–80	0. 20–0. 63	0. 10–0. 14	5. 6–6. 5	18–26	95–110	Low-------	Low-------	Moderate.
80–100	80–100	55–95	35–80	0. 63–2. 00	0. 08–0. 12	5. 6–6. 5	14–29	89–115	Low-------	Low-------	Moderate.
95–100	90–100	85–95	75–85	0. 63–2. 00	0. 16–0. 20	5. 1–6. 0	-------	---------	Low-------	Low-------	High.
80–100	75–100	70–95	50–85	0. 63–2. 00	0. 12–0. 16	4. 5–5. 5	12–18	110–120	Low-------	Low-------	High.
30–80	20–75	15–70	15–55	2. 00–6. 30	0. 02–0. 06	5. 1–6. 5	12–16	115–120	Low-------	Low-------	High.
90–100	90–100	70–100	40–65	2. 00–6. 30	0. 15–0. 17	5. 5–6. 5	10–14	110–130	Low-------	Moderate---	Moderate.
35–75	30–60	20–50	0–45	>6. 30	0. 01–0. 03	5. 5–6. 5	8–13	115–120	Low-------	Low-------	Moderate.
90–100	85–100	75–100	60–95	0. 63–6. 30	0. 16–0. 20	4. 5–6. 0	-------	---------	Low-------	Moderate---	High.
50–100	50–100	40–100	40–95	0. 20–0. 63	0. 08–0. 12	4. 5–6. 0	14–20	105–117	Low-------	High-------	High.
40–95	40–75	30–60	25–40	0. 20–0. 63	0. 06–0. 10	5. 1–6. 5	11–16	110–120	Low-------	Moderate---	High.
80–95	70–95	60–90	55–85	0. 63–2. 00	0. 14–0. 18	5. 1–6. 0	-------	---------	Low-------	High-------	High.
65–90	40–80	40–75	35–60	<0. 20	0. 06–0. 12	5. 1–6. 0	15–20	104–112	Moderate---	High-------	High.
90–100	85–100	70–100	45–85	0. 63–2. 00	0. 18–0. 20	4. 5–6. 0	-------	---------	Moderate---	Moderate---	Moderate.
90–100	85–100	70–100	45–85	0. 20–0. 63	0. 15–0. 17	4. 5–6. 0	10–14	110–120	Moderate---	Moderate---	Moderate.
55–80	50–70	50–70	35–55	2. 00–6. 30	0. 08–0. 14	4. 5–6. 0	8–12	115–120	Low-------	Moderate---	Moderate.
65–90	60–80	45–60	25–50	2. 00–6. 30	0. 14–0. 16	4. 5–5. 5	-------	---------	Low-------	Low-------	High.
45–95	40–80	30–60	15–45	2. 00–6. 30	0. 06–0. 13	4. 5–5. 5	9–13	115–130	Low-------	Low-------	High.
85–100	80–100	80–100	75–100	00. 2–6. 30	0. 16–0. 18	6. 1–7. 3	-------	---------	Low-------	High------	High.
85–100	80–100	75–100	75–100	<0. 20	0. 12–0. 16	6. 1–7. 3	17–22	95–109	Moderate---	High-------	Moderate.
80–100	75–100	60–90	40–80	<0. 20	0. 08–0. 12	6. 1–7. 3	14–18	110–118	Moderate---	High-------	Moderate.

TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to— Seasonal high water table	Bedrock	Depth from surface (typical profile)	Classification: USDA texture (typical profile)	Unified	AASHO	Coarse fraction greater than 3 inches
	Feet	*Feet*	*Inches*				*Percent*
*Urban land: Ub, Uc, UdB, UdC, Uh, UlB, UlC. Properties too variable to estimate. For Abbottstown part of Uc, see Abbottstown series. For Chester part of UdB and UdC, see Chester series. For Howell part of Uh, see Howell series. For Lansdale part of UlB and UlC, see Lansdale series.							
Urbana: UrA, UrB	1–2	4–6	0–10	Silt loam	ML, CL	A–4	
			10–39	Silty clay loam	ML, CL	A–4	
			39–50	Very gravelly clay loam	SM, SC, ML	A–4	
Washington: WaB	>3	5–10	0–22	Gravelly silt loam, silt loam	ML	A–4	
			22–48	Gravelly clay loam, gravelly silty clay.	ML–CL	A–4, A–6, A–7	
			48–56	Gravelly clay loam	ML–CL, ML, SC, GM	A–2, A–4, A–6	0–15
*Weikert: WcD. For Cullcoka part, see Culleoka series.	>3	1–1½	0–8	Shaly silt loam	GM, ML	A–1, A–2, A–4	0–10
			8–18	Very shaly silt loam	GM, GP–GM	A–1, A–2	0–20
			18	Shale, siltstone, and thin-bedded sandstone.			
Woodstown: WoA	1½–3	4–12	0–18	Silt loam	ML, ML–CL	A–4	
			18–32	Gravelly sandy clay loam, sandy clay loam.	SM, SC	A–2, A–4, A–6	
			32–50	Sandy clay loam	SM, SC	A–2, A–4, A–6	

significant in engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Optimum moisture	Maximum dry density	Shrink-swell potential	Corrosion potential for—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Steel	Concrete
				Inches per hour	*Inches per inch of soil*	*pH*	*Percent*	*Pounds per cubic foot*			
85–100	85–95	75–85	65–80	0.63–2.00	0.16–0.20	5.1–6.5	------	------	Low	High	High.
85–100	85–100	80–95	65–90	<0.20	0.08–0.16	5.1–6.5	14–18	104–111	Low	High	High.
75–90	75–90	65–80	40–75	<0.20	0.08–0.12	5.1–6.5	14–17	105–115	Low	High	High.
80–100	75–95	65–90	55–85	0.63–2.00	0.15–0.18	5.6–6.5	------	------	Low	Moderate	Moderate.
80–100	75–95	65–90	55–85	0.63–2.00	0.11–0.16	5.6–6.5	14–20	106–112	Moderate	Low	Moderate.
65–90	60–85	50–80	30–70	0.63–2.00	0.10–0.14	5.6–7.3	13–18	108–114	Low	Low	Moderate.
30–70	25–65	25–60	20–55	2.00–6.30	0.08–0.14	5.1–6.5	------	------	Low	Low	High.
25–55	20–40	10–35	5–25	2.00–6.30	0.07–0.11	5.1–6.5	11–15	115–122	Low	Low	High.
100	100	90–100	65–90	0.63–2.00	0.16–0.20	4.0–5.5	------	------	Low	High	High.
95–100	70–100	60–90	20–45	0.63–2.00	0.08–0.12	4.0–5.5	10–17	100–110	Moderate	High	High.
90–100	80–100	60–90	20–45	0.63–2.00	0.08–0.12	4.0–5.5	10–15	115–125	Moderate	High	High.

TABLE 6.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may that appear in

Soil series and map symbols	Suitability as source of			Soil features affecting—		
	Topsoil	Sand and gravel	Road fill	Highway and road location	Ponds	
					Reservoir area	Embankment
Abbottstown: AbA, AbB, AbC.	Fair	Unsuitable	Fair	Seasonal high water table; seepage along fragipan.	Features generally favorable.	Erodible
Allenwood: AdB, AdC, AdD.	Fair	Unsuitable	Good	Features generally favorable.	Pervious material	Pervious material; erodible.
Alluvial land: Ae	Poor	Variable	Variable	Subject to flooding.	Pervious material; subject to flooding.	Pervious material; stones and cobblestones.
Alton: AgA, AgB, AlA.	Poor	Fair to good	Good	Cut slopes are droughty; AlA subject to flooding.	Pervious material; AlA subject to flooding.	Pervious material
Bedington: BeA, BeB, BeC.	Good	Unsuitable	Fair	Features generally favorable.	Pervious material	Fair stability; pervious material; erodible.
Bowmansville: Bo	Good	Unsuitable	Fair	High water table; subject to flooding.	Pervious substratum; seasonal high water table at a depth of 0 to ½ foot; subject to flooding.	Erodible
Chalfont: CaA, CaB	Fair	Unsuitable	Fair	Seasonal high water table; high frost heaving potential.	Pervious substratum.	Moderate stability; erodible.
Chester: CeA, CeB, CeC, CeD, ChD.	Good. Poor in stony areas.	Unsuitable	Fair	Micaceous material; poor stability.	Pervious material; stony in places.	Pervious material; poor compaction characteristics; stony in places.
Clarksburg: ClB	Fair	Unsuitable	Fair	Seasonal high water table; high frost heaving potential.	Moderately pervious material.	Erodible
*Culleoka: CwB, CwC. For Weikert part, see Weikert series.	Fair to poor.	Unsuitable	Good	Bedrock at a depth of 2 to 3½ feet.	Pervious bedrock at a depth of 2 to 3½ feet.	Pervious material; fair stability.
Doylestown: DoA, DoB.	Fair	Unsuitable	Poor	High water table; poor stability; high frost heaving potential.	Seasonal high water table at a depth of 0 to ½ foot.	Poor stability; erodible.

interpretations

have different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series the first column]

Soil features affecting—Continued					
Drainage of cropland and pasture	Sprinkler irrigation	Terraces or diversions	Grassed waterways	Pipeline construction and maintenance	Suitability for winter grading
Seasonal high water table; slow permeability.	Seasonal high water table; slow permeability.	Seepage along fragipan.	Seepage along fragipan; erodible.	Seasonal high water table.	Poor.
Well drained	Slope, where more than 15 percent.	Erodible	Erodible	Moderate corrosion potential.	Fair.
High water table	High water table; subject to flooding.	High water table; subject to flooding.	High water table; subject to flooding.	High water table; subject to flooding.	Poor.
Well drained	Low available moisture capacity.	Irregular topography; AlA subject to flooding.	Irregular topography; AlA subject to flooding.	Subject to caving; AlA subject to flooding.	Good.
Well drained	Features generally favorable.	Erodible	Erodible	Moderate corrosion potential.	Fair.
High water table; outlet problems; moderately slow permeability; subject to flooding.	High water table; subject to flooding.	Generally not needed.	High water table; subject to flooding.	High water table; subject to flooding.	Poor.
Seasonal high water table; slow permeability.	Seasonal high water table; slow permeability.	Seasonal high water table.	Seasonal high water table; erodible.	Seasonal high water table.	Poor.
Stony in places	Slope, where more than 15 percent.	Stony in places	Stony in places	Moderate corrosion potential.	Good.
Seasonal high water table; slow permeability.	Seasonal high water table; slow permeability.	Seasonal high water table.	Seasonal high water table.	Seasonal high water table; moderate corrosion potential.	Fair.
Well drained	Low available water capacity.	Bedrock at a depth of 2 to 3½ feet.	Bedrock at a depth of 2 to 3½ feet.	Bedrock at a depth of 2 to 3½ feet.	Good.
High water table; slow permeability.	High water table; slow permeability.	High water table	High water table	High water table	Poor.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability as source of			Soil features affecting—		
	Topsoil	Sand and gravel	Road fill	Highway and road location	Ponds	
					Reservoir area	Embankment
*Duffield: DsB, DtC. For Washington part of DtC, see Washington series.	Good	Unsuitable	Fair	Features generally favorable.	Pervious material; possible sinks and channels in limestone bedrock.	Pervious material; erodible.
Duncannon: DuA, DuB.	Good	Unsuitable	Fair	Features generally favorable.	Pervious material.	Pervious material; erodible.
Fallsington, gravelly subsoil variant: Fa.	Fair	Fair	Good	High water table; high frost heaving potential.	Pervious substratum; seasonal high water table.	Erodible
Hatboro: Ha	Fair	Unsuitable	Fair	High water table; subject to flooding.	Pervious substratum; seasonal high water table; subject to flooding.	Erodible
Howell: HoA, HoB	Fair	Unsuitable	Fair	Features generally favorable.	Features generally favorable.	Poor stability; erodible.
Klinesville: KlB, KlC, KlD.	Poor	Unsuitable	Fair: limited quantity.	Bedrock at a depth of 1 foot to 1½ feet.	Pervious bedrock at a depth of 1 foot to 1½ feet.	Fair stability; limited quantity.
Lansdale: LaA, LaB, LaC, LaD, LdB, LdD, LdE.	Fair. Poor in stony areas.	Poor	Good	Features generally favorable.	Pervious material; stony in places.	Pervious material; stony in places.
Lawrenceville: LgA, LgB.	Fair	Unsuitable	Fair	Seasonal high water table; high frost heaving potential.	Features generally favorable.	Moderate stability; erodible.
Lehigh: LhB, LhC, LlD.	Fair. Poor in stony areas.	Unsuitable	Fair	Seasonal high water table.	Stony in places	Erodible; stony in places.
*Manor: MaB, MaC, MaD, MbD, McE. For Chester part of McE, see Chester series.	Fair. Poor in stony areas.	Unsuitable	Fair	Micaceous material; poor stability.	Pervious material; stony in places.	Pervious material; poor compaction characteristics; erodible; stony in places.
Marsh: Mh. Properties too variable to be interpreted.						
Mount Lucas: MlA, MlB, MlC, MoB, MoD.	Fair. Poor in stony areas.	Unsuitable	Fair	Seasonal high water table; moderate frost heaving potential.	Stony in places	Fair stability; stony in places; erodible.

interpretations—Continued

Soil features affecting—Continued: Drainage of cropland and pasture	Sprinkler irrigation	Terraces or diversions	Grassed waterways	Pipeline construction and maintenance	Suitability for winter grading
Well drained	Features generally favorable.	Erodible	Erodible	Moderate corrosion potential.	Fair.
Well drained	Features generally favorable.	Erodible	Erodible	Moderate corrosion potential.	Fair.
High water table	High water table	Generally not needed.	High water table	High water table; high corrosion potential.	Poor.
High water table; outlet problems; subject to flooding.	High water table; subject to flooding.	Generally not needed.	High water table; subject to flooding.	High water table; subject to flooding.	Poor.
Well drained	Moderately slow permeability.	Poor stability; erodible.	Poor stability; erodible.	Features generally favorable.	Fair.
Well drained	Very low available water capacity; slopes of more than 15 percent.	Bedrock at a depth or 1 foot to 1½ feet.	Bedrock at a depth of 1 foot to 1½ feet; low fertility.	Bedrock at a depth of 1 foot to 1½ feet.	Good.
Stony in places	Slope, where more than 15 percent.	Stony in places	Stony in places	Features generally favorable.	Good.
Seasonal high water table; moderately slow permeability.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; erodible.	Seasonal high water table; erodible.	Seasonal high water table; moderate corrosion potential.	Poor.
Seasonal high water table; slow permeability; stony in places.	Seasonal high water table; slow permeability; slope, where more than 15 percent.	Seasonal high water table; stony in places.	Seasonal high water table; stony in places.	Seasonal high warer table; moderate to high corrosion potential.	Fair.
Well drained	Features generally favorable.	Erodible	Erodible	Moderate corrosion potential.	Fair.
Seasonal high water table; slow permeability; stony in places.	Seasonal high water table; slow permeability; slope, more than 15 percent.	Seasonal high water table; stony in places.	Seasonal high water table; stony in places.	Seasonal high water table.	Poor.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability as source of— Topsoil	Sand and gravel	Road fill	Soil features affecting— Highway and road location	Ponds: Reservoir area	Ponds: Embankment
Neshaminy: NeB, NeC, NhB, NhD, NhE.	Fair. Poor in stony areas.	Unsuitable	Fair	Moderate frost heaving potential.	Pervious material; stoniness in stony areas.	Difficult to compact; stoniness in stony areas; erodible.
*Penn: PeA, PeB, PeC, PeD, PhB3, PkC3, PlD, PlE, PnB, PnC. For Klinesville part of PhB3, PkC3, PlD, and PlE, see Klinesville series. For Lansdale part of PnB and PnC, see Lansdale series.	Fair. Poor in stony areas.	Unsuitable	Good	Bedrock at a depth of 1½ to 3½ feet; stony in places.	Pervious bedrock at a depth of 1½ to 3½ feet; stony in places.	Pervious material; fair stability; stony in places.
Pope: PoA, PpA, PpB.	Good	Fair	Good	Features generally favorable on terrace phases; subject to flooding.	Pervious material; subject to flooding.	Erodible
Readington: RdA, RdB, RdC.	Fair	Unsuitable	Fair	Seasonal high water table; moderate frost heaving potential.	Moderately pervious material.	Fair stability; erodible.
Reaville: ReA, ReB, ReC.	Poor	Unsuitable	Fair	Seasonal high water table; bedrock at depth of 1½ to 3½ feet.	Pervious bedrock at a depth of 1½ to 2½ feet.	Many shale fragments.
Rowland: Ro	Good	Unsuitable	Fair	Seasonal high water table; subject to flooding.	Pervious substratum; subject to flooding.	Erodible
Steinsburg: StB, StC, StD.	Poor	Fair	Good	Bedrock at a depth of 2 to 3½ feet.	Pervious material; bedrock at a depth of 2 to 3½ feet.	Pervious material; erodible.
Towhee: ToA, ToB, TwB.	Poor	Unsuitable	Poor	High water table; high frost heaving potential.	Seasonal high water table; stony in places.	Poor stability; stony in places.

interpretations—Continued

Soil features affecting—Continued					Suitability for winter grading
Drainage of cropland and pasture	Sprinkler irrigation	Terraces or diversions	Grassed waterways	Pipeline construction and maintenance	
Well drained; stoniness in stony areas.	No unfavorable features; slope, where more than 15 percent.	Stoniness in stony areas.	Stoniness in stony areas.	Low to moderate corrosion potential.	Fair.
Well drained; stony in places.	Low available water capacity; slope, where more than 15 percent.	Bedrock at a depth of 1½ to 3½ feet; surface stoniness in places.	Bedrock at a depth of 1½ to 3½ feet; surface stoniness in places.	Bedrock at a depth of 1½ to 3½ feet.	Good.
Well drained	Features generally favorable.	Features generally favorable on terrace phases; subject to flooding.	Features generally favorable on terrace phases; subject to flooding.	Features generally favorable on terrace phases; subject to flooding.	Fair.
Seasonal high water table; moderately slow permeability.	Seasonal high water table; moderately slow permeability.	Seasonal high water table; erodible.	Seasonal high water table; erodible.	Seasonal high water table; high corrosion potential.	Poor.
Seasonal high water table; bedrock at depth of 1½ to 3½ feet.	Seasonal high water table; slow permeability.	Seasonal high water table; bedrock at a depth of 1½ to 3½ feet.	Seasonal high water table; bedrock at a depth of 1½ to 3½ feet.	Seasonal high water table; bedrock at a depth of 1½ to 3½ feet; high corrosion potential.	Poor.
Seasonal high water table; subject to flooding.	Seasonal high water table; subject to flooding.	Generally not needed.	Seasonal high water table; subject to flooding.	Seasonal high water table; subject to flooding.	Poor.
Well drained	Low available water capacity; slope where slope is more than 15 percent.	Bedrock at a depth of 2 to 3½ feet.	Bedrock at a depth of 2 to 3½ feet.	Bedrock at a depth of 2 to 3½ feet.	Good.
High water table; slow permeability; stony in places.	High water table; slow permeability.	High water table; stony in places.	High water table; stony in places.	High water table; high corrosion potential.	Poor.

TABLE 6.—*Engineering*

Soil series and map symbols	Suitability as source of			Soil features affecting—		
	Topsoil	Sand and gravel	Road fill	Highway and road location	Ponds	
					Reservoir area	Embankment
*Urban land: Ub, Uc, UdB, UdC, Uh, UlB, UlC. Urban land too variable to be rated; requires onsite investigation. For Abbottstown part of Uc, see Abbottstown series. For Chester part of UdB and UdC, see Chester series. For Howell part of Uh, see Howell series. For Lansdale part of UlB and UlC, see Lansdale series.						
Urbana: UrA, UrB	Fair	Unsuitable	Fair	Seasonal high water table; poor stability.	Features generally favorable.	Erodible; poor compaction characteristics.
Washington: WaB	Good	Unsuitable	Fair	Features generally favorable.	Pervious material; possible sinks.	Pervious material; erodible.
*Weikert: WcD. For Culleoka part, see Culleoka series.	Poor	Unsuitable	Fair: limited quantity.	Bedrock at a depth of 1 foot to 1½ feet.	Pervious bedrock at a depth of 1 foot to 1½ feet.	Fair stability; limited quantity.
Woodstown: WoA	Fair	Unsuitable	Poor	Seasonal high water table; moderate frost heaving potential.	Features generally favorable.	Fair stability; erodible.

interpretations—Continued

Soil features affecting—Continued: Drainage of cropland and pasture	Sprinkler irrigation	Terraces or diversions	Grassed waterways	Pipeline construction and maintenance	Suitability for winter grading
Seasonal high water table; slow permeability.	Seasonal high water table; slow permeability.	Seasonal high water table; erodible.	Seasonal high water table; erodible.	Seasonal high water table; high corrosion potential.	Fair.
Well drained	Features generally favorable.	Erodible	Erodible	Moderate corrosion potential.	Fair.
Well drained	Very low available water capacity; slope, where more than 15 percent.	Bedrock at a depth of 1 foot to 1½ feet.	Bedrock at a depth of 1 foot to 1½ feet.	Bedrock at a depth of 1 foot to 1½ feet.	Good.
Seasonal high water table; moderate permeability.	Seasonal high water table; moderate permeability.	Seasonal high water table; erodible.	Seasonal high water table; erodible.	Seasonal high water table; high corrosion potential.	Fair.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Corrosivity, as used in table 5, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to soil properties such as drainage, texture, total acidity, and electrical conductivity. Ratings of soils for corrosivity of concrete are based mainly on soil texture and acidity. Installations that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that there is little probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protective measures should be used to avoid or minimize damage to steel and the more corrosion resistant concrete.

Engineering interpretations of soils

The estimated interpretations in table 6 are based on the engineering properties of soils shown in table 5, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Bucks and Philadelphia Counties. In table 6, ratings of *good*, *fair*, and *poor* indicate the suitability of the soils for all listed purposes other than for highway and road location, winter grading, drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, terraces and diversions, grassed waterways, and pipeline construction. For these particular uses, table 6 lists those soil features not to be overlooked in planning, installation, and maintenance.

Topsoil is used to topdress an area where a plant cover is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; by natural fertility of the material, or by response of plants when fertilizer is applied; and by absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 6 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit.

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and the relative ease of excavating the material at borrow areas.

Soil properties that most affect highway and road location are load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have a low seepage rate, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments and dikes require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Stones or organic materials in a soil are among factors that are unfavorable.

Drainage of cropland and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff and seepage so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Waterway layout and construction are affected by such soil properties as texture, depth, and erodibility of the soil material; presence of stones or rock outcrops; and the steepness of slopes. Other factors affecting waterways are seepage, natural soil drainage, available water capacity, susceptibility to siltation, and the ease of establishing and maintaining vegetation.

Shallow excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries are those that generally require digging or trenching to a depth of less than 6 feet. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

Winter grading is affected chiefly by soil features that are relevant to moving, mixing, and compacting soil in roadbuilding when temperatures are below freezing.

Town and Country Planning and Recreation

This section provides soil information useful in planning outdoor recreation facilities. It also provides a sound basis for developing land use plans for Bucks and Philadelphia Counties and their political subdivisions. Interpretive maps can be made from the soil maps along with information provided in tables 7 and 8. These interpretations help in determining the degree and kind of limitations of the soils in any given area.

The information in this section is presented for general guidance of officials and developers who are concerned with selecting suitable sites for various purposes. *While this information and the soil maps give general guidance, it is emphasized that the mapping and written information are restricted in detail by the map scale and should be used only in planning more detailed field investigations to determine the inplace condition of the soil at any specific site.*

Soil features alone are evaluated in this section, since the ease or difficulty of making improvement is largely controlled by the characteristics of the soils. However, it is recognized that location and economic factors often decide the ultimate use of an area regardless of soil limitations involved.

Tables 7 and 8 show the estimated degree and kinds of limitations for specific uses of the soils. Soil features that have an important effect in town and country planning and recreational uses are depth to bedrock, permeability, flooding, presence of water table, surface texture, slope, and stoniness. Limitations are classified as slight, moderate, and severe. A rating of *slight* indicates that the soil area in question generally has few limitations for the use being considered. A rating of *moderate* indicates that the soil has limitations that require special practices to overcome or correct. A rating of *severe* indicates that the soil has limitations very difficult or expensive to overcome or correct. A rating of severe does not imply that the soil cannot be used for the purpose shown. It does indicate a greater degree of limitation than for slight or moderate. Variable is listed for those units where the degree and kinds of limitations cannot be determined with reasonable accuracy.

Onsite sewage effluent disposal.—The main features affecting use of soils for sewage effluent disposal systems are permeability, steepness of slope, depth to bedrock, and level of the water table. Also, in soils underlain by cavernous limestone, fractured shale, and sand or gravel, the underground water may become contaminated by seepage of effluent through rock crevices, coarse materials, or solution channels. Size of drainage field and type of disposal system used are often affected by the degree and kind of limitation. Soils with a *severe* rating should be carefully investigated before decisions are made concerning installation of disposal systems. For systems used only for short periods, such as for summer camp, limitations may be less severe than indicated in the table.

Sewage lagoons.—The main features affecting use of soils for sewage lagoons are permeability for the substratum, slope, depth to bedrock, stoniness, and the hazard of flooding.

Buildings of three stories or less with basements.—The main features affecting soil use for buildings of three stories or less in height that have less than an 8-foot excavation for basements are occurrences of and depth to water table, depth to and kind of bedrock, slope, and the hazard of flooding. Depth to bedrock and occurrence of a water table are less important when buildings are constructed without basements.

Lawns and landscaping.—In these ratings the needs for lime and fertilizer are not considered. Suitable soil material is needed in amounts sufficient for desirable trees and other plants to survive and grow. Among the factors considered are depth to seasonal high water table, depth to bedrock, soil texture, presence of stones or rocks, and the hazard of flooding.

Subdivision streets and parking lots.—The main features affecting use of soils for streets and parking lots in subdivisions are occurrence of and depth to water table, slope, depth to and kind of bedrock, stoniness, and the hazard of flooding. For roads outside of subdivisions, slope is generally less of a limitation than shown on the table.

Sanitary landfills.—These are areas used for the disposal of trash and garbage by the trench method. The main requirement is enough soil material to cover the refuse and garbage; no importation of fill or cover material is considered in the ratings. The main features considered are depth to bedrock, the hazard of flooding, occurrence of water table, and stoniness or rockiness. Sinkholes in limestone should not be used for refuse disposal because of risk of contamination of ground water supplies. Esthetic, economic, and sociological factors, while important, are not considered in the ratings.

Cemeteries.—The main features affecting use of soils for cemeteries are depth to bedrock, the hazard of flooding, rockiness, stoniness, soil texture, and occurrence of and depth to water table.

Campsites.—Soil ratings apply to areas suitable for tents or camping trailers and travel trailers and the accompanying activities for outdoor living. These areas are used frequently during the camping season, which normally extends from May 30 until Labor Day. The ratings assume little site preparation other than shaping and leveling tent and parking areas. The site should be suitable for heavy foot traffic and vehicular traffic. Suitability of soil for supporting vegetation is a separate item to be considered in the final evaluation in selecting sites for these uses.

Service buildings in recreational areas (without basements).—These are sites for washrooms, bathhouses, picnic shelters, other service buildings without basements, and seasonal or year-round cottages. The degree of limitation is more severe if buildings are to be constructed with basements (see table 7).

Paths and trails in camping areas.—These are areas that are to be used for trails, hiking and bridle paths, and nonintensive uses that allow for random movement of people. It is assumed that these areas are to be used as

TABLE 7.—*Degree and kind of limitation to be*

[The ratings given a soil complex or undifferentiated group

Soil series and map symbols	Sewage effluent disposal by onsite septic tank	Sewage lagoons	Buildings with basements (three stories or less)
Abbottstown:			
AbA	Severe: slow permeability; seasonal high water table.	Slight	Severe: seasonal high water table.
AbB	Severe: slow permeability; seasonal high water table.	Moderate: slope	Severe: seasonal high water table.
AbC	Severe: slow permeability; seasonal high water table.	Severe: slope	Severe: seasonal high water table.
Allenwood:			
AdB	Slight	Moderate: moderate permeability.	Slight
AdC	Moderate: slope	Severe: slope	Moderate: slope
AdD	Severe: slope	Severe: slope	Severe: slope
Alluvial land: Ae	Severe: subject to flooding	Severe: subject to flooding	Severe: subject to flooding
Alton:			
AgA	Slight: hazard of ground water contamination.	Severe: rapid permeability	Slight
AgB	Slight: hazard of ground water contamination.	Severe: rapid permeability	Slight
AlA	Severe: flooding	Severe: rapid permeability; flooding.	Severe: flooding
Bedington:			
BeA	Slight	Moderate: moderate permeability.	Slight
BeB	Slight	Moderate: moderate permeability; slope.	Slight
BeC	Moderate: slope	Severe: slope	Moderate: slope
Bowmansville: Bo	Severe: high water table; flooding.	Severe: flooding	Severe: high water table; flooding.
Chalfont:			
CaA	Severe: slow permeability; seasonal high water table.	Slight	Severe: seasonal high water table.
CaB	Severe: slow permeability; seasonal high water table.	Moderate: slope	Severe: seasonal high water table.
Chester:			
CeA	Slight	Severe: moderately rapid permeability in substratum.	Slight
CeB	Slight	Severe: moderately rapid permeability in substratum.	Slight
CeC	Moderate: slope	Severe: moderately rapid permeability in substratum; slope.	Moderate: slope
CeD	Severe: slope	Severe: slope	Severe: slope
ChD	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness
Clarksburg: ClB	Severe: seasonal high water table; slow permeability.	Moderate: hazard of ground water contamination; slope.	Moderate: seasonal high ater table.
Culleoka-Weikert:			
CwB	Severe: bedrock at a depth of 1 foot to 3½ feet.	Severe: bedrock at a depth of 1 foot to 3½ feet; moderately rapid permeability.	Moderate: bedrock at a depth of 1 foot to 3½ feet.
CwC	Severe: bedrock at a depth of 1 foot to 3½ feet.	Severe: bedrock at a depth of 1 foot to 3½ feet; slope.	Moderate: bedrock at a depth of 1 foot to 3½ feet; slope.
Doylestown:			
DoA	Severe: high water table	Slight	Severe: high water table
DoB	Severe: seasonal high water table.	Moderate: slope	Severe: seasonal high water table.
Duffield: DsB	Slight: hazard of ground water contamination.	Moderate: moderate permeaability; hazard of ground water contamination.	Slight

considered in community development

apply to both of the series named in the first column]

Lawns and landscaping	Subdivision streets and parking lots	Trench method sanitary landfills	Community cemeteries
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: seasonal high water table.	Severe: seasonal high water table.
Moderate: seasonal high water table.	Severe: slope	Severe: seasonal high water table.	Severe: seasonal high water table.
Slight	Moderate: slope	Slight	Slight.
Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: subject to flooding	Severe: subject to flooding	Severe: subject to flooding	Severe: subject to flooding.
Slight	Slight	Slight: hazard of ground water contamination.	Slight.
Slight	Moderate: slope	Slight: hazard of ground water contamination.	Slight.
Slight	Slight	Moderate: flooding	Moderate: flooding.
Slight	Slight	Slight	Slight.
Slight	Moderate: slope	Slight	Slight.
Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope.
Severe: high water table	Severe: high water table; flooding.	Severe: high water table; flooding.	Severe: high water table; flooding.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Slight	Slight	Slight	Slight.
Slight	Moderate: slope	Slight	Slight.
Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness.
Slight	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Moderate: bedrock at a depth of 1 foot to 3½ feet.	Moderate: bedrock at a depth of 1 foot to 3½ feet.	Severe: bedrock at a depth of 1 foot to 3½ feet.	Severe: bedrock at a depth of 1 foot to 3½ feet.
Moderate: bedrock at a depth of 1 foot to 3½ feet; slope.	Severe: slope	Severe: bedrock at a depth of 1 foot to 3½ feet; slope.	Severe: bedrock at a depth of 1 foot to 3½ feet.
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Slight	Moderate: slope	Slight: hazard of ground water contamination.	Slight.

TABLE 7.—*Degree and kind of limitation to be*

Soil series and map symbols	Sewage effluent disposal by onsite septic tank	Sewage lagoons	Buildings with basements (three stories or less)
Duffield and Washington: DtC	Moderate: hazard of ground water contamination; slope.	Severe: slope	Moderate: slope
Duncannon:			
DuA	Slight	Moderate: moderate permeability.	Slight
DuB	Slight	Moderate: moderate permeability; slope.	Slight
Fallsington, gravelly subsoil variant: Fa.	Severe: high water table	Severe: moderate permeability in substratum.	Severe: high water table
Hatboro: Ha	Severe: seasonal high water table; flooding.	Severe: flooding	Severe: seasonal high water table; flooding.
Howell:			
HoA	Severe: moderately slow permeability.	Slight	Slight
HoB	Severe: moderately slow permeability.	Slight	Slight
Klinesville:			
KlB	Severe: bedrock at a depth of 1 foot to 1½ feet.	Severe: bedrock at a depth of 1 foot to 1½ feet.	Moderate: bedrock at a depth of 1 foot to 1½ feet.
KlC	Severe: bedrock at a depth of 1 foot to 1½ feet.	Severe: bedrock at a depth of 1 foot to 1½ feet; slope.	Moderate: bedrock at a depth of 1 foot to 1½ feet, slope.
KlD	Severe: bedrock at a depth of 1 foot to 1½ feet; slope.	Severe: bedrock at a depth of 1½ feet; slope.	Severe: slope
Lansdale:			
LaA	Slight	Severe: moderately rapid permeability in substratum.	Slight
LaB	Slight	Severe: moderately rapid permeability in substratum.	Slight
LaC	Moderate: slope	Severe: slope	Moderate: slope
LaD	Severe: slope	Severe: slope	Severe: slope
LdB	Severe: stoniness	Severe: moderately rapid permeability; stoniness.	Severe: stoniness
LdD	Severe: stoniness; slope	Severe: moderately rapid permeability; stoniness; slope.	Severe: stoniness; slope
LdE	Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope
Lawrenceville:			
LgA	Severe: moderately slow permeability.	Slight	Moderate: seasonal high water table.
LgB	Severe: moderately slow permeability.	Moderate: slope	Moderate: seasonal high water table.
Lehigh:			
LhB	Severe: seasonal high water table; slow permeability.	Moderate: slope	Moderate: seasonal high water table.
LhC	Severe: seasonal high water table; slow permeability.	Severe: slope	Severe: seasonal high water table; slope.
LlD	Severe: slow permeability; seasonal high water table; stoniness; slope.	Severe: stoniness; slope	Severe: stoniness; slope
Manor:			
MaB	Slight: hazard of ground water contamination.	Severe: moderately rapid permeability.	Slight
MaC	Moderate: hazard of ground water contamination: slope.	Severe: slope	Moderate: slope
MaD	Severe: slope	Severe: slope	Severe: slope
MbD	Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope
Manor and Chester: McE	Severe: stoniness: slope	Severe: stoniness; slope	Severe: stoniness; slope
Marsh: Mh	Sefere: high water table; flooding.	Severe: flooding	Severe: high water table; flooding.

considered in community development—Continued

Lawns and landscaping	Subdivision streets and parking lots	Trench method sanitary landfills [1]	Community cemeteries
Moderate: slope	Severe: slope	Moderate: hazard of ground water contamination; slope.	Moderate: slope.
Slight	Slight	Slight	Slight.
Slight	Moderate: slope	Slight	Slight.
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.	Severe: seasonal high water table; flooding.
Slight	Slight	Slight	Slight.
Slight	Moderate: slope	Slight	Slight.
Moderate: bedrock at a depth of 1 foot to 1½ feet.	Moderate: bedrock at a depth of 1 foot to 1½ feet.	Severe: bedrock at a depth of 1 foot to 1½ feet.	Severe: bedrock at a depth of 1 foot to 1½ feet.
Moderate: bedrock at a depth of 1 foot to 1½ feet; slope.	Severe: slope	Severe: bedrock at a depth of 1 foot to 1½ feet.	Severe: bedrock at a depth of 1 foot to 1½ feet.
Severe: slope	Severe: slope	Severe: bedrock at a depth of 1 foot to 1½ feet; slope.	Severe: bedrock at a depth of 1 foot to 1½ feet; slope.
Slight	Slight	Slight	Slight.
Slight	Moderate: slope	Slight	Slight.
Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: stoniness	Severe: stoniness	Severe: stoniness	Severe: stoniness.
Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope.
Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope.
Slight	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Slight	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Slight	Moderate: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Moderate: slope	Severe: slope	Severe: seasonal high water table.	Severe: seasonal high water table.
Severe: stoniness; slope	Severe: stoniness; slope	Severe: seasonal high water table; stoniness; slope.	Severe: seasonal high water table; stoniness; slope.
Slight	Moderate: slope	Slight	Slight.
Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope.
Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope.
Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope.
Severe: high water table; flooding.	Severe: high water table; flooding.	Severe: high water table; flooding.	Severe: high water table; flooding.

TABLE 7.—*Degree and kind of limitation to be*

Soil series and map symbols	Sewage effluent disposal by onsite septic tank	Sewage lagoons	Buildings with basements (3 stories or less)
Mount Lucas:			
MlA	Severe: slow permeability; seasonal high water table.	Slight	Moderate: seasonal high water table.
MlB	Severe: slow permeability; seasonal high water table.	Moderate: slope	Moderate: seasonal high water table.
MlC	Severe: slow permeability; seasonal high water table.	Severe: slope	Moderate: seasonal high water table; slope.
MoB	Severe: slow permeability; seasonal high water table; stoniness.	Severe: stoniness	Severe: stoniness
MoD	Severe: slow permeability; seasonal high water table; stoniness; slope.	Severe: stoniness; slope	Severe: stoniness; slope
Neshaminy:			
NeB	Slight	Moderate: slope	Slight
NeC	Moderate: slope	Severe: slope	Moderate: slope
NhB	Severe: stoniness	Severe: stoniness	Severe: stoniness
NhD	Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope
NhE	Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope
Penn:			
PeA	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet; moderate permeability.	Moderate: bedrock at a depth of 1½ to 3½ feet.
PeB	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet; moderate permeability.	Moderate: bedrock at a depth of 1½ to 3½ feet.
PeC	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: bedrock at a depth 1½ to 3½ feet; slope.
PeD	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: slope	Severe: slope
Penn-Klinesville:			
PhB3	Severe: bedrock at a depth of 1 foot to 3½ feet.	Severe: bedrock at a depth of 1 foot to 3½ feet.	Moderate: bedrock at a depth of 1 foot to 3½ feet.
PkC3	Severe: bedrock at a depth of 1 foot to 3½ feet.	Severe: bedrock at a depth of 1 foot to 3½ feet; slope.	Moderate: bedrock at a depth of 1 foot to 3½ feet; slope.
PlD, PlE	Severe: bedrock at a depth of 1 foot to 3½ feet; stoniness; slope.	Severe: bedrock at a depth of 1 foot to 3½ feet; stoniness; slope.	Severe: stoniness; slope
Penn-Lansdale:			
PnB	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet; moderately rapid permeability in substratum.	Moderate: bedrock at a depth of 1½ to 3½ feet.
PnC	Severe: bedrock at a depth of 1½ to 3½ feet.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.
Pope:			
PoA	Severe: flooding	Severe: rapid permeability; flooding.	Severe: flooding
PpA	Slight	Severe: rapid permeability	Slight
PpB	Slight	Severe: rapid permeability	Slight
Readington:			
RdA	Severe: moderately slow permeability.	Slight	Moderate: seasonal high water table.
RdB	Severe: moderately slow permeability.	Moderate: slope	Moderate: seasonal high water table.
RdC	Severe: moderately slow permeability.	Severe: slope	Moderate: seasonal high water table; slope.

considered in community development—Continued

Lawns and landscaping	Subdivision streets and parking lots	Trench method sanitary landfills [1]	Community cemeteries
Slight	Moderate: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Slight	Moderate: seasonal high water table; slope.	Severe: seasonal high water table.	Severe: seasonal high water table.
Moderate: slope	Severe: slope	Severe: seasonal high water table.	Severe: seasonal high water table.
Severe: stoniness	Severe: stoniness	Severe: seasonal high water table; stoniness.	Severe: seasonal high water table; stoniness.
Severe: stoniness; slope	Severe: stoniness; slope	Severe: seasonal high water table; stoniness; slope.	Severe: seasonal high water table; stoniness; slope.
Slight	Moderate: slope	Slight	Slight.
Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope.
Severe: stoniness	Severe: stoniness	Severe: stoniness	Severe: stoniness.
Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope.
Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope	Severe: stoniness; slope.
Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.
Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.
Moderate: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: slope	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.
Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Moderate: bedrock at a depth of 1 foot to 3½ feet.	Moderate: bedrock at a depth of 1 foot to 3½ feet.	Severe: bedrock at a depth of 1 foot to 3½ feet.	Severe: bedrock at a depth of 1 foot to 3½ feet.
Moderate: bedrock at a depth of 1 foot to 3½ feet; slope.	Severe: slope	Severe: bedrock at a depth of 1 foot to 3½ feet; slope.	Severe: bedrock at a depth of 1 foot to 3½ feet; slope.
Severe: stoniness; slope	Severe: stoniness; slope	Severe: bedrock at a depth of 1 foot to 3½ feet; stoniness; slope.	Severe: bedrock at a depth of 1 foot to 3½ feet; stoniness; slope.
Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.
Moderate: bedrock at a depth of 1½ to 3½ feet; slope.	Severe: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.
Slight	Slight	Moderate: flooding	Moderate: flooding.
Slight	Slight	Slight	Slight.
Slight	Moderate: slope	Slight	Slight.
Slight	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Slight	Moderate: seasonal high water table; moderately slow permeability.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Moderate: slope	Severe: seasonal high water table; slope.	Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.

TABLE 7.—*Degree and kind of limitation to be*

Soil series and map symbols	Sewage effluent disposal by onsite septic tank	Sewage lagoons	Buildings with basements (three stories or less)
Reaville:			
ReA	Severe: bedrock at a depth of 1½ to 2½ feet; seasonal high water table; slow permeability.	Severe: bedrock at a depth of 1½ to 2½ feet.	Moderate: bedrock at a depth of 1½ to 2½ feet; seasonal high water table.
ReB	Severe: bedrock at a depth of 1½ to 2½ feet; seasonal high water table; slow permeability.	Severe: bedrock at a depth of 1½ to 2½ feet; slope.	Moderate: bedrock at a depth of 1½ to 2½ feet; seasonal high water table.
ReC	Severe: bedrock at a depth of 1½ to 2½ feet; seasonal high water table; slow permeability.	Severe: bedrock at a depth of 1½ to 2½ feet; slope.	Moderate: bedrock at a depth of 1½ to 2½ feet; seasonal high water table; slope.
Rowland: Ro	Severe: flooding	Severe: flooding	Severe: flooding
Steinsburg:			
StB	Severe: bedrock at a depth of 2 to 3½ feet.	Severe: bedrock at a depth of 2 to 3½ feet.	Severe: bedrock at a depth of 2 to 3½ feet.
StC	Severe: bedrock at a depth of 2 to 3½ feet.	Severe: bedrock at a depth of 2 to 3½ feet.	Severe: bedrock at a depth of 2 to 3½ feet.
StD	Severe: bedrock at a depth of 2 to 3½ feet; slope.	Severe: bedrock at a depth of 2 to 3½ feet; slope.	Severe: bedrock at a depth of 2 to 3½ feet; slope.
Towhee:			
ToA	Severe: high water table; slow permeability.	Slight	Severe: high water table
ToB	Severe: high water table; slow permeability.	Moderate: slope	Severe: high water table
TwB	Severe: high water table; slow permeability; stoniness.	Severe: stoniness	Severe: high water table; stoniness.
Urban land: Ub. Too variable to rate; requires onsite investigation.			
Urban land-Abbottstown: Uc	Severe: seasonal high water table; slow permeability.	Moderate: slope	Severe: seasonal high water table.
Urban land-Chester:			
UdB	Slight	Severe: moderately rapid permeability in substratum.	Slight
UdC	Moderate: slope	Severe: slope	Moderate: slope
Urban land-Howell: Uh	Severe: moderately slow permeability.	Slight	Slight
Urban land-Lansdale:			
UlB	Slight	Severe: moderately rapid permeability.	Slight
UlC	Moderate: slope	Severe: slope	Moderate: slope
Urbana:			
UrA	Severe: slow permeability	Slight	Severe: seasonal high water table.
UrB	Severe: slow permeability	Moderate: slope	Severe: seasonal high water table.
Washington: WaB	Slight: hazard of ground water contamination.	Moderate: moderate permeability; hazard of ground water pollution; slope.	Slight
Weikert-Culleoka: WcD	Severe: bedrock at a depth of 1 foot to 3½ feet; slope.	Severe: bedrock at a depth of 1 foot to 3½ feet; slope.	Severe: slope
Woodstown: WoA	Severe: moderately slow permeability.	Slight	Moderate: seasonal high water table.

[1] In landfills more than 5 or 6 feet deep, onsite study is needed of the underlying strata and water table to determine the hazards of aquifer pollution and drainage into ground water.

considered in community development—Continued

Lawns and landscaping	Subdivision streets and parking lots	Trench method sanitary landfills [1]	Community cemeteries
Moderate: bedrock at a depth of 1½ to 2½ feet.	Moderate: bedrock at a depth of 1½ to 2½ feet; seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Moderate: bedrock at a depth of 1½ to 2½ feet.	Moderate: bedrock at a depth of 1½ to 2½ feet; seasonal high water table; slope.	Severe: seasonal high water table.	Severe: seasonal high water table.
Moderate: bedrock at a depth of 1½ to 2½ feet; slope.	Severe: slope	Severe: seasonal high water table.	Severe: seasonal high water table.
Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding.
Moderate: bedrock at a depth of 2 to 3½ feet; surface texture.	Severe: bedrock at a depth of 2 to 3½ feet.	Severe: bedrock at a depth of 2 to 3½ feet.	Severe: bedrock at a depth of 2 to 3½ feet.
Moderate: bedrock at a depth of 2 to 3½ feet; surface texture; slope.	Severe: bedrock at a depth of 2 to 3½ feet; slope.	Severe: bedrock at a depth of 2 to 3½ feet.	Severe: bedrock at a depth of 2 to 3½ feet.
Severe: slope	Severe: bedrock at a depth of 2 to 3½ feet; slope.	Severe: bedrock at a depth of 2 to 3½ feet; slope.	Severe: bedrock at a depth of 2 to 3½ feet; slope.
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Severe: high water table; stoniness.	Severe: high water table; stoniness.	Severe: high water table; stoniness.	Severe: high water table; stoniness.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Slight	Moderate: slope	Slight	Slight.
Severe: slope	Severe: slope	Moderate: slope	Moderate: slope.
Slight	Moderate: slope	Slight	Slight.
Slight	Moderate: slope	Slight	Slight.
Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.
Slight	Moderate: slope	Slight: hazard of gound water contamination.	Slight.
Severe: bedrock at depth of 1 foot to 3½ feet; slope.	Severe: slope	Severe: bedrock at a depth of 1 foot to 3½ feet; slope.	Severe: bedrock at a depth of 1 foot to 3½ feet; slope.
Slight	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.

TABLE 8.—*Degree and kind of limitation*

[The ratings given a soil complex or undifferentiated group apply to

Soil series and map symbols	Campsites		Service buildings in recreational areas (without basements)
	Tents	Trailers	
Abbottstown:			
AbA	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table.
AbB	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability; slope.	Moderate: seasonal high water table.
AbC	Moderate: seasonal high water table; slow permeability; slope.	Severe: slope	Moderate: seasonal high water table; slope.
Allenwood:			
AdB	Moderate: gravelly	Moderate: gravelly; slope	Slight
AdC	Moderate: gravelly; slope	Severe: slope	Moderate: slope
AdD	Severe: slope	Severe: slope	Severe: slope
Alluvial land: Ae	Severe: subject to flooding	Severe: subject to flooding	Severe: subject to flooding
Alton:			
AgA	Moderate: gravelly	Moderate: gravelly	Slight
AgB	Moderate: gravelly	Moderate: gravelly; slope	Slight
AlA	Moderate: gravelly	Moderate: gravelly	Moderate: flooding
Bedington:			
BeA	Slight	Slight	Slight
BeB	Slight	Moderate: slope	Slight
BeC	Moderate: slope	Severe: slope	Moderate: slope
Bowmansville: Bo	Severe: high water table; flooding.	Severe: high water table; flooding.	Severe: flooding
Chalfont:			
CaA	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table.
CaB	Moderate: seasonal high water table; slow permeability; slope.	Moderate: seasonal high water table; slow permeability; slope.	Moderate: seasonal high water table.
Chester:			
CeA	Slight	Slight	Slight
CeB	Slight	Moderate: slope	Slight
CeC	Moderate: slope	Severe: slope	Moderate: slope
CeD	Severe: slope	Severe: slope	Severe: slope
ChD	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness
Clarksburg: ClB	Moderate: slow permeability	Moderate: slow permeability; slope.	Slight
Culleoka-Weikert:			
CwB	Moderate: shaly	Moderate: shaly; slope	Moderate: bedrock at a depth of 1 foot to 3 ½ feet.
CwC	Moderate: shaly; slope	Severe: slope	Moderate: bedrock at a depth of 1 foot to 3½ feet; slope.
Doylestown:			
DoA	Severe: high water table	Severe: high water table	Severe: high water table
DoB	Severe: high water table	Severe: high water table	Severe: high water table
Duffield: DsB	Slight	Moderate: slope	Slight
Duffield and Washington: DtC	Moderate: slope	Severe: slope	Moderate: slope
Duncannon:			
DuA	Slight	Slight	Slight
DuB	Slight	Moderate: slope	Slight

for recreational facilities

both of the series named in the first column]

Paths and trails in camping areas	Picnic and play areas	Athletic fields	Golf fairways
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: seasonal high water table; slope.	Moderate: seasonal high water table; slope.
Moderate: gravelly	Moderate: gravelly	Severe: gravelly	Moderate: gravelly.
Moderate: gravelly	Moderate: gravelly; slope	Severe: gravelly; slope	Moderate: gravelly; slope.
Moderate: gravelly; slope	Severe: slope	Severe: gravelly; slope	Severe: slope.
Severe: high water table; subject to flooding.	Severe: high water table	Severe: high water table	Severe: subject to flooding.
Moderate: gravelly	Moderate: gravelly	Severe: gravelly	Moderate: gravelly.
Moderate: gravelly	Moderate: gravelly	Severe: gravelly	Moderate: gravelly.
Moderate: gravelly	Moderate: gravelly	Severe: gravelly	Moderate: gravelly.
Slight	Slight	Slight	Slight.
Slight	Slight	Moderate: slope	Slight.
Slight	Moderate: slope	Severe: slope	Moderate: slope.
Severe: high water table; flooding.	Severe: high water table; flooding.	Severe: high water table; flooding.	Severe: high water table; flooding.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Slight	Slight	Slight	Slight.
Slight	Slight	Moderate: slope	Slight.
Slight	Moderate: slope	Severe: slope	Moderate: slope.
Moderate: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: stoniness	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness.
Slight	Slight	Moderate: seasonal high water table; slow permeability; slope.	Slight.
Moderate: shaly	Moderate: shaly	Moderate: bedrock at a depth of 1 foot to 3½ feet.	Severe: bedrock at a depth of 1 foot to 3½ feet.
Moderate: shaly	Moderate: shaly; slope	Severe: bedrock at a depth of 1 foot to 3½ feet; shaly; slope.	Severe: bedrock at a depth of 1 foot to 3½ feet; slope.
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Slight	Slight	Moderate: slope	Slight.
Slight	Moderate: slope	Severe: slope	Moderate: slope.
Slight	Slight	Slight	Slight.
Slight	Slight	Moderate: slope	Slight.

TABLE 8.—*Degree and kind of limitation*

Soil series and map symbols	Campsites		Service buildings in recreational areas (without basements)
	Tents	Trailers	
Fallsington, gravelly subsoil variant: Fa.	Severe: high water table	Severe: high water table	Severe: high water table
Hatboro: Ha	Severe: high water table; flooding.	Severe: high water table; flooding.	Severe: flooding
Howell:			
HoA	Moderate: moderately slow permeability.	Moderate: moderately slow permeability.	Slight
HoB	Moderate: moderately slow permeability.	Moderate: moderately slow permeability; slope.	Slight
Klinesville:			
KlB	Moderate: shaly	Moderate: shaly; slope	Moderate: bedrock at a depth of 1 foot to 1½ feet.
KlC	Moderate: shaly; slope	Severe: slope	Moderate: bedrock at a depth of 1 foot to 1½ feet.
KlD	Severe: slope	Severe: slope	Severe: slope
Lansdale:			
LaA	Slight	Slight	Slight
LaB	Slight	Moderate: slope	Slight
LaC	Moderate: slope	Severe: slope	Moderate: slope
LaD	Severe: slope	Severe: slope	Severe: slope
LdB	Severe: stoniness	Severe: stoniness	Severe: stoniness
LdD	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness
LdE	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness
Lawrenceville:			
LgA	Moderate: moderately slow permeability.	Moderate: moderately slow permeability.	Slight
LgB	Moderate: moderately slow permeability.	Moderate: moderately slow permeability; slope.	Slight
Lehigh:			
LhB	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability; slope.	Moderate: seasonal high water table.
LhC	Moderate: seasonal high water table; slow permeability; slope.	Severe: slope	Moderate: seasonal high water table; slope.
LlD	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness
Manor:			
MaB	Slight	Moderate: slope	Slight
MaC	Moderate: slope	Severe: slope	Moderate: slope
MaD	Severe: slope	Severe: slope	Severe: slope
MbD	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness
Manor and Chester: McE	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness
Marsh: Mh	Severe: high water table	Severe: high water table	Severe: high water table
Mount Lucas:			
MlA	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table.
MlB	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability; slope.	Moderate: seasonal high water table.
MlC	Moderate: seasonal high water table; slow permeability; slope.	Severe: slope	Moderate: seasonal high water table; slope.
MoB	Severe: stoniness	Severe: slope; stoniness	Severe: stoniness
MoD	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness

for recreational facilities—Continued

Paths and trails in camping areas	Picnic and play areas	Athletic fields	Golf fairways
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Severe: high water table; flooding.	Severe: high water table; flooding.	Severe: high water table; flooding.	Severe: high water table; flooding.
Slight	Slight	Moderate: moderately slow permeability.	Slight.
Slight	Slight	Moderate: moderately slow permeability; slope.	Slight.
Moderate: shaly	Moderate: shaly	Severe: bedrock at a depth of 1 foot to 1½ feet.	Severe: bedrock at a depth of 1 foot to 1½ feet.
Moderate: shaly	Moderate: shaly; slope	Severe: bedrock at a depth of 1 foot to 1½ feet; slope.	Severe: bedrock at a depth of 1 foot to 1½ feet.
Moderate: shaly; slope	Severe: slope	Severe: bedrock at a depth of 1 foot to 1½ feet; slope.	Severe: bedrock at a depth of 1 foot to 1½ feet; slope.
Slight	Slight	Slight	Slight.
Slight	Slight	Moderate: slope	Slight.
Slight	Moderate: slope	Severe: slope	Moderate: slope.
Moderate: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: stoniness	Severe: stoniness	Severe: stoniness	Severe: stoniness.
Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope: stoniness	Severe: slope; stoniness.
Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness.
Slight	Slight	Moderate: seasonal high water table; moderately slow permeability.	Slight.
Slight	Slight	Moderate: seasonal high water table; moderately slow permeability; slope.	Slight.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Severe: seasonal high water table; slope.	Moderate: seasonal high water table; slope.
Severe: seasonal high water table; stoniness.	Severe: slope; stoniness	Severe: seasonal high water table; stoniness.	Severe: slope; stoniness.
Slight	Slight	Slight	Slight.
Slight	Moderate: slope	Severe: slope	Moderate: slope.
Moderate: slope	Severe: slope	Severe: slope	Severe: slope.
Severe: stoniness	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness.
Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness.
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table; slope.
Severe: stoniness	Severe: stoniness	Severe: seasonal high water table; stoniness.	Severe: stoniness.
Severe: stoniness	Severe: slope; stoniness	Severe: seasonal high water table; slope; stoniness.	Severe: slope; stoniness.

TABLE 8.—*Degree and kind of limitation*

Soil series and map symbols	Campsites		Service buildings in recreational areas (without basements)
	Tents	Trailers	
Neshaminy:			
NeB	Moderate: channery	Moderate: channery; slope	Slight
NeC	Moderate: channery; slope	Severe: slope	Moderate: slope
NhB	Severe: stoniness	Severe: stoniness	Severe: stoniness
NhD	Severe: stoniness	Severe: slope; stoniness	Severe: slope; stoniness
NhE	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness
Penn:			
PeA	Slight	Slight	Slight
PeB	Slight	Moderate: slope	Slight
PeC	Moderate: slope	Severe: slope	Moderate: slope
PeD	Severe: slope	Severe: slope	Severe: slope
Penn-Klinesvile:			
PhB3	Moderate: shaly	Moderate: shaly; slope	Moderate: bedrock at a depth of 1 foot to 3½ feet.
PkC3	Moderate: shaly; slope	Severe: slope	Moderate: bedrock at a depth of 1 foot to 3½ feet; slope.
PlD	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness
PlE	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness
Penn-Lansdale:			
PnB	Slight	Moderate: slope	Slight
PnC	Moderate: slope	Severe: slope	Moderate: slope
Pope:			
PoA	Slight	Slight	Moderate: flooding
PpA	Slight	Slight	Slight
PpB	Slight	Moderate: slope	Slight
Readington:			
RdA	Moderate: moderately slow permeability.	Moderate: moderately slow permeability; slope.	Slight
RdB	Moderate: moderately slow permeability.	Moderate: moderately slow permeability; slope.	Slight
RdC	Moderate: moderately slow permeability; slope.	Severe: slope	Moderate: slope
Reaville:			
ReA	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table.
ReB	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability; slope.	Moderate: seasonal high water table.
ReC	Moderate: seasonal high water table; slow permeability; slope.	Severe: slope	Moderate: seasonal high water table; slope.
Rowland: Ro	Moderate: moderately slow permeability; flooding.	Moderate: moderately slow permeability; flooding.	Severe: flooding
Steinsburg:			
StB	Moderate: gravelly	Moderate: gravelly; slope	Slight
StC	Moderate: gravelly; slope	Severe: slope	Moderate: slope
StD	Severe: slope	Severe: slope	Severe: slope

for recreational facilities—Continued

Paths and trails in camping areas	Picnic and play areas	Athletic fields	Golf fairways
Moderate: channery	Moderate: channery	Severe: channery	Moderate: channery.
Moderate: channery	Moderate: channery; slope	Severe: channery; slope	Moderate: channery; slope.
Severe: stoniness	Severe: stoniness	Severe: stoniness	Severe: stoniness.
Severe: stoniness	Severe: stoniness	Severe: slope; stoniness	Severe: stoniness.
Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness.
Slight	Slight	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.
Slight	Slight	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.
Slight	Moderate: slope	Severe: slope	Moderate: bedrock at a depth of 1½ to 3½ feet; slope.
Moderate: slope	Severe: slope	Severe: slope	Severe: slope.
Moderate: shaly	Moderate: shaly	Severe: bedrock at a depth of 1 foot to 3½ feet.	Severe: bedrock at a depth of 1 foot to 3½ feet.
Moderate: shaly	Moderate: shaly; slope	Severe: bedrock at a depth of 1 foot to 3½ feet; slope.	Severe: bedrock at a depth of 1 foot to 3½ feet.
Severe: stoniness	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness.
Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness	Severe: slope; stoniness.
Slight	Slight	Moderate: bedrock at a depth of 1½ to 3½ feet.	Moderate: bedrock at a depth of 1½ to 3½ feet.
Slight	Moderate: slope	Severe: slope	Moderate: bedrock at a depth of 1½ to 3½ feet.
Slight	Slight	Slight	Slight.
Slight	Slight	Slight	Slight.
Slight	Slight	Moderate: slope	Slight.
Slight	Slight	Moderate: seasonal high water table; moderately slow permeability; slope.	Slight.
Slight	Slight	Moderate: seasonal high water table; moderately slow permeability; slope.	Slight.
Slight	Moderate: slope	Severe: slope	Moderate: slope.
Moderate: seasonal high water table.	Moderate: seasonal high water table; shaly.	Severe: seasonal high water table; shaly.	Moderate: seasonal high water table; bedrock at a depth of 1½ to 2½ feet; shaly.
Moderate: seasonal high water table.	Moderate: seasonal high water table; shaly.	Severe: seasonal high water table; shaly.	Moderate: seasonal high water table; bedrock at a depth of 1½ to 2½ feet; shaly.
Moderate: seasonal high water table.	Moderate: seasonal high water table; shaly; slope.	Severe: seasonal high water table; shaly; slope.	Moderate: seasonal high water table; bedrock at a depth of 1½ to 2½ feet; slope.
Slight	Severe: flooding	Moderate: seasonal high water table; moderately slow permeability; flooding.	Moderate: flooding.
Moderate: gravelly	Moderate: gravelly	Severe: gravelly	Moderate: bedrock at a depth or 2 to 3½ feet; gravelly.
Moderate: gravelly	Moderate: gravelly; slope	Severe: gravelly; slope	Moderate: bedrock at a depth of 2 to 3½ feet; gravelly; slope.
Moderate: gravelly; slope	Severe: slope	Severe: gravelly; slope	Severe: slope.

TABLE 8.—*Degree and kind of limitation*

Soil series and map symbols	Campsites		Service buildings in recreational areas (without basements)
	Tents	Trailers	
Towhee:			
ToA, ToB	Severe: high water table	Severe: high water table	Severe: high water table
TwB	Severe: high water table; stoniness.	Severe: seasonal high water table; stoniness.	Severe: high water table; stoniness.
Urban land: Ub. Too variable. Onsite investigation required.			
Urban land-Abbottstown: Uc.	Moderate: seasonal high water table; slow permeability.	Moderate: seasonal high water table; slow permeability; slope.	Moderate: seasonal high water table.
Urban land-Chester:			
UdB	Slight	Moderate: slope	Slight
UdC	Moderate: slope	Severe: slope	Moderate: slope
Urban land-Howell: Uh	Moderate: moderately slow permeability; slope.	Severe: slope	Moderate: slope
Urban land-Lansdale:			
UlB	Slight	Moderate: slope	Slight
UlC	Moderate: slope	Severe: slope	Moderate: slope
Urbana:			
UrA	Moderate: slow permeability	Moderate: slow permeability	Moderate: seasonal high water table.
UrB	Moderate: slow permeability	Moderate: slow permeability; slope.	Moderate: seasonal high water table.
Washington: WaB	Moderate: gravelly	Moderate: gravelly; slope	Slight
Weikert-Culleoka: WcD	Severe: slope	Severe: slope	Severe: slope
Woodstown: WoA	Moderate: moderately slow permeability.	Moderate: moderately slow permeability.	Slight

for recreational facilities—Continued

Paths and trails in camping areas	Picnic and play areas	Athletic fields	Golf fairways
Severe: high water table	Severe: high water table	Severe: high water table	Severe: high water table.
Severe: high water table; stoniness.	Severe: high water table; stoniness.	Severe: high water table; stoniness.	Severe: high water table; stoniness.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Severe: seasonal high water table.	Moderate: seasonal high water table.
Slight	Slight	Moderate: slope	Slight.
Slight	Moderate: slope	Severe: slope	Moderate: slope.
Slight	Moderate: slope	Severe: slope	Moderate: slope.
Slight	Slight	Moderate: slope	Slight.
Slight	Moderate: slope	Severe: slope	Moderate: slope.
Slight	Slight	Severe: seasonal high water table.	Moderate: seasonal high water table.
Slight	Slight	Severe: seasonal high water table.	Moderate: seasonal high water table.
Moderate: gravelly	Moderate: gravelly	Severe: gravelly	Moderate: gravelly.
Moderate: shaly; slope	Severe: slope	Severe: bedrock at a depth of 1 foot to 3½ feet; shaly; slope.	Severe: bedrock at a depth of 1 foot to 3½ feet; slope.
Slight	Slight	Moderate: seasonal high water table; moderately slow permeability.	Slight.

they occur in nature, with little soil moved (excavated) for the planned recreational use.

Picnic and play areas.—These are areas to be developed for hiking, picnicking, and casual play where only light foot traffic is expected. The ratings are based on soil features only and do not include other features, such as the presence of trees or lakes, which may affect the desirability of a site. The main soil features considered are depth to seasonal high water table, soil slope, depth to bedrock, flood hazard, and rockiness and stoniness. Water supply, sewage disposal, and suitability of the soil for supporting vegetation are separate items to be considered in the final evaluation in selecting sites for these uses.

Athletic fields.—These are areas to be developed as playgrounds for organized games, such as baseball, football, badminton, etc. Areas selected for this use are subject to intensive foot traffic; therefore, a nearly level surface, good drainage, and a soil texture and consistence that gives a firm surface are generally required. The most desirable soils are also free of rock outcrops and coarse fragments. It is assumed that good plant cover can be established and maintained on areas where needed.

Golf fairways.—These are areas to be used for turf, shrubs, and trees without adding topsoil. Traps, roughs, and greens are specialized features not considered in ratings for golf fairways. Among the factors considered are depth to seasonal high water table, soil slope, depth to bedrock, soil texture, rockiness or stoniness, and flood hazard.

Descriptions of the Soils

This section describes the soil series and mapping units of Bucks and Philadelphia Counties. The acreage and proportionate extent of each mapping unit are given in table 9. Their location and extent in the two-county area are shown on the soil map at the back of the survey.

The procedure is first to describe the soil series, and then the mapping units in that series. Thus, to get full information about any mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. As mentioned in the section "How This Survey Was Made," not all mapping

TABLE 9.—*Approximate acreage and proportionate extent of the soils*

Soil	Acreage			Percent of total
	Bucks County	Philadelphia County	Total	
Abbottstown silt loam, 0 to 3 percent slopes	10, 580	0	10, 580	2. 2
Abbottstown silt loam, 3 to 8 percent slopes	21, 715	0	21, 715	4. 7
Abbottstown silt loam, 8 to 15 percent slopes	1, 715	0	1, 715	. 4
Allenwood gravelly silt loam, 3 to 8 percent slopes	1, 775	0	1, 775	. 4
Allenwood gravelly silt loam, 8 to 15 percent slopes	1, 755	0	1, 755	. 4
Allenwood gravelly silt loam, 15 to 25 percent slopes	720	0	720	. 2
Alluvial land	1, 955	150	2, 105	. 4
Alton gravelly loam, 0 to 3 percent slopes	2, 630	10	2, 640	. 6
Alton gravelly loam, 3 to 8 percent slopes	615	0	615	. 1
Alton gravelly loam, flooded, 0 to 5 percent slopes	2, 250	0	2, 250	. 5
Bedington silt loam, 0 to 3 percent slopes	1, 125	0	1, 125	. 2
Bedington silt loam, 3 to 8 percent slopes	2, 520	0	2, 520	. 5
Bedington silt loam, 8 to 15 percent slopes	695	0	695	. 1
Bowmansville silt loam	27, 970	0	27, 970	6. 0
Chalfont silt loam, 0 to 3 percent slopes	4, 145	60	4, 205	. 9
Chalfont silt loam, 3 to 8 percent slopes	1, 955	30	1, 985	. 4
Chester silt loam, 0 to 3 percent slopes	595	50	645	. 1
Chester silt loam, 3 to 8 percent slopes	3, 595	925	4, 520	1. 0
Chester silt loam, 8 to 15 percent slopes	1, 960	220	2, 180	. 5
Chester silt loam, 15 to 25 percent slopes	800	35	835	. 2
Chester extremely stony loam, 8 to 25 percent slopes	1, 435	0	1, 435	. 3
Clarksburg silt loam, 2 to 6 percent slopes	1, 060	0	1, 060	. 2
Culleoka-Weikert shaly silt loams, 3 to 8 percent slopes	1, 305	0	1, 305	. 3
Culleoka-Weikert shaly silt loams, 8 to 15 percent slopes	1, 690	0	1, 690	. 4
Doylestown silt loam, 0 to 3 percent slopes	20, 855	85	20, 940	4. 4
Doylestown silt loam, 3 to 8 percent slopes	14, 415	0	14, 415	3. 0
Duffield silt loam, 2 to 8 percent slopes	1, 485	5	1, 490	. 3
Duffield and Washington soils, 8 to 20 percent slopes	1, 200	0	1, 200	. 3
Duncannon silt loam, 0 to 3 percent slopes	4, 245	605	4, 850	1. 0
Duncannon silt loam, 3 to 8 percent slopes	2, 350	265	2, 615	. 6
Fallsington silt loam, gravelly subsoil variant	2, 005	0	2, 005	. 4
Hatboro silt loam	6, 430	720	7, 150	1. 5
Howell silt loam, 0 to 3 percent slopes	505	0	505	. 1
Howell silt loam, 3 to 8 percent slopes	710	0	710	. 2
Klinesville very shaly silt loam, 3 to 8 percent slopes	3, 540	0	3, 540	. 7
Klinesville very shaly silt loam, 8 to 15 percent slopes	4, 525	0	4, 525	1. 0
Klinesville very shaly silt loam, 15 to 25 percent slopes	3, 415	0	3, 415	. 7
Lansdale loam, 0 to 3 percent slopes	920	0	920	. 2
Lansdale loam, 3 to 8 percent slopes	9, 080	0	9, 080	1. 9
Lansdale loam, 8 to 15 percent slopes	2, 595	0	2, 595	. 5

TABLE 9.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Acreage			Percent of total
	Bucks County	Philadelphia County	Total	
Lansdale loam, 15 to 25 percent slopes	540	0	540	0. 1
Lansdale extremely stony loam, 0 to 8 percent slopes	600	0	600	. 1
Lansdale extremely stony loam, 8 to 25 percent slopes	2, 210	0	2, 210	. 5
Lansdale extremely stony loam, 25 to 50 percent slopes	1, 685	0	1, 685	. 4
Lawrenceville silt loam, 0 to 3 percent slopes	6, 995	80	7, 075	1. 5
Lawrenceville silt loam, 3 to 8 percent slopes	6, 795	65	6, 860	1. 4
Lehigh channery silt loam, 2 to 8 percent slopes	4, 005	0	4, 005	. 8
Lehigh channery silt loam, 8 to 18 percent slopes	1, 375	0	1, 375	. 3
Lehigh extremely stony silt loam, 8 to 25 percent slopes	575	0	575	. 1
Manor loam, 3 to 8 percent slopes	490	1, 060	1, 550	. 3
Manor loam, 8 to 15 percent slopes	885	1, 170	2, 055	. 4
Manor loam, 15 to 25 percent slopes	450	695	1, 145	. 2
Manor extremely stony loam, 8 to 25 percent slopes	60	740	800	. 2
Manor and Chester extremely stony loams, 25 to 50 percent slopes	1, 275	1, 270	2, 545	. 5
Marsh	545	505	1, 050	. 2
Mount Lucas silt loam, 0 to 3 percent slopes	870	0	870	. 2
Mount Lucas silt loam, 3 to 8 percent slopes	3, 240	0	3, 240	. 7
Mount Lucas silt loam, 8 to 15 percent slopes	535	0	535	. 1
Mount Lucas extremely stony silt loam, 0 to 8 percent slopes	7, 055	0	7, 055	1. 5
Mount Lucas extremely stony silt loam, 8 to 25 percent slopes	2, 555	0	2, 555	. 5
Neshaminy channery silt loam, 3 to 8 percent slopes	1, 910	0	1, 910	. 4
Neshaminy channery silt loam, 8 to 15 percent slopes	775	0	775	. 2
Neshaminy extremely stony silt loam, 0 to 8 percent slopes	4, 125	0	4, 125	. 9
Neshaminy extremely stony silt loam, 8 to 25 percent slopes	6, 775	0	6, 775	1. 4
Neshaminy extremely stony silt loam, 25 to 50 percent slopes	1, 325	0	1, 325	. 3
Penn silt loam, 0 to 3 percent slopes	685	0	685	. 1
Penn silt loam, 3 to 8 percent slopes	5, 510	0	5, 510	1. 2
Penn silt loam, 8 to 15 percent slopes	1, 800	0	1, 800	. 4
Penn silt loam, 15 to 25 percent slopes	470	0	470	. 1
Penn-Klinesville shaly silt loams, 3 to 8 percent slopes, eroded	2, 445	0	2, 245	. 5
Penn-Klinesville complex, 8 to 15 percent slopes, eroded	1, 645	0	1, 645	. 3
Penn-Klinesville extremely stony silt loams, 8 to 25 percent slopes	1, 420	0	1, 420	. 3
Penn-Klinesville extremely stony silt loams, 25 to 50 percent slopes	3, 810	0	3, 810	. 8
Penn-Lansdale complex, 3 to 8 percent slopes	3, 230	0	3, 230	. 7
Penn-Lansdale complex, 8 to 15 percent slopes	1, 130	0	1, 130	. 2
Pope loam, 0 to 5 percent slopes	1, 530	0	1, 530	. 3
Pope loam, terrace, 0 to 3 percent slopes	2, 990	15	3, 005	. 6
Pope loam, terrace, 3 to 10 percent slopes	980	0	980	. 2
Readington silt loam, 0 to 3 percent slopes	4, 785	0	4, 785	1. 0
Readington silt loam, 3 to 8 percent slopes	12, 815	0	12, 815	2. 7
Readington silt loam, 8 to 15 percent slopes	1, 340	0	1, 340	. 3
Reaville shaly silt loam, 0 to 3 percent slopes	3, 520	0	3, 520	. 7
Reaville shaly silt loam, 3 to 8 percent slopes	16, 685	0	16, 685	3. 5
Reaville shaly silt loam, 8 to 15 percent slopes	4, 430	0	4, 430	. 9
Rowland silt loam	1, 585	475	2, 060	. 4
Steinsburg gravelly loam, 3 to 8 percent slopes	1, 530	0	1, 530	. 3
Steinsburg gravelly loam, 8 to 15 percent slopes	1, 450	0	1, 450	. 3
Steinsburg gravelly loam, 15 to 25 percent slopes	450	0	450	. 1
Towhee silt loam, 0 to 3 percent slopes	4, 330	0	4, 300	. 9
Towhee silt loam, 3 to 8 percent slopes	3, 595	0	3, 595	. 8
Towhee extremely stony silt loam, 0 to 8 percent slopes	11, 435	0	11, 435	2. 4
Urban land	1, 635	43, 315	44, 950	9. 4
Urban land-Abbottstown complex	9, 265	25	9, 290	2. 0
Urban land-Chester complex, 0 to 8 percent slopes	7, 640	23, 245	30, 885	6. 5
Urban land-Chester complex, 8 to 15 percent slopes	1, 930	2, 000	3, 930	. 8
Urban land-Howell complex	21, 135	4, 155	25, 290	5. 5
Urban land-Lansdale complex, 0 to 8 percent slopes	11, 985	0	11, 985	2. 5
Urban land-Lansdale complex, 8 to 15 percent slopes	2, 265	0	2, 265	. 5
Urbana silt loam, 0 to 3 percent slopes	1, 130	90	1, 220	. 2
Urbana silt loam, 3 to 8 percent slopes	1, 540	0	1, 540	. 3
Washington gravelly silt loam, 3 to 8 percent slopes	635	0	635	. 1
Weikert-Culleoka shaly silt loams, 15 to 25 percent slopes	835	0	835	. 2
Woodstown silt loam, 0 to 5 percent slopes	560	0	560	. 1
Quarries and gravel pits	1, 810	0	1, 810	. 4
Cut and fill land	1, 615	0	1, 615	. 3
Water	900	175	1, 075	. 2
Total	392, 960	82, 240	475, 200	100. 0

units are members of a soil series. Urban land, for example, is a miscellaneous land type that does not belong to a soil series. It is listed, nevertheless, in alphabetical order along with the soil series. Described along with some mapping units are small areas of contrasting soils that were included in some of the areas mapped. Unless otherwise stated colors are for moist soils.

In comparing a mapping unit with a soil series, many will prefer to read the short description in paragraph form. It precedes the technical description that identifies layers in a representative profile by A, B, C, and R horizons and depth ranges. The technical profile descriptions are mainly for soil scientists and others who want detailed information about soils. Technical terms are defined in the Soil Survey Manual (*16*).

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit in which the mapping unit has been placed. The page on which each of the capability units is described can be found by referring to the "Guide to Mapping Units" at the back of this survey.

Abbottstown Series

The Abbottstown series consists of deep, somewhat poorly drained, nearly level to sloping soils on uplands. These soils are at the base of slopes, on side slopes, and on broad ridgetops. They formed in loamy material weathered from red and brown shale and sandstone.

In a representative profile in a cultivated area, the plow layer is dark-brown silt loam about 8 inches thick. The subsoil extends to a depth of about 42 inches. It is reddish-brown silt loam in the upper 7 inches and reddish-brown silt loam, shaly silt loam, and shaly clay loam in the lower part. The lower part has pink, yellow, brown, and gray mottles. Reddish-brown, mottled very shaly silty clay loam is between depths of 42 and 46 inches and overlies fractured, red shale bedrock.

Runoff is slow, and the hazard of erosion is slight to moderate. The available water capacity is moderate, and permeability is slow. The water table generally rises to within 6 to 18 inches of the surface during wet seasons. Slow permeability and wetness are limitations to most nonfarm uses of these soils.

Representative profile of Abbottstown silt loam, 0 to 3 percent slopes, in a hayfield 55 feet west of Quarry Road, in Bedminster Township:

Ap—0 to 8 inches, dark-brown (7.5YR 4/2) silt loam; weak, very fine, granular structure; friable; 5 percent shale fragments; medium acid; abrupt, smooth boundary.

B2t—8 to 15 inches, reddish-brown (5YR 5/4) silt loam; common, medium, distinct, light reddish-brown (5YR 6/3) mottles; weak, medium, subangular blocky structure; friable; few, thin, patchy clay films; very strongly acid; clear, wavy boundary.

Bx1—15 to 26 inches, reddish-brown (5YR 4/4) heavy silt loam; many, coarse, prominent, brownish-yellow (10YR 6/6) mottles; ped faces are pink (5YR 7/3); weak, thick, platy structure parting to moderate, fine, subangular blocky; firm and brittle, slightly sticky and slightly plastic; thin clay films on faces of peds; less than 2 percent shale fragments; strongly acid; abrupt, wavy boundary.

Bx2—26 to 35 inches, reddish-brown (5YR 4/3) shaly heavy silt loam; common, coarse, prominent, strong-brown (7.5YR 5/6) mottles; ped faces are pink (5YR 7/3); weak, very coarse, prismatic structure parting to moderate, very thick, platy; firm and brittle, slightly sticky and slightly plastic; thin, continuous clay films; 20 percent shale fragments; strongly acid; clear, wavy boundary.

Bx3—35 to 42 inches, reddish-brown (5YR 4/3) shaly clay loam; common, medium, prominent, grayish-brown (2.5Y 5/2) and pink (7.5YR 8/4) mottles; weak, thick, platy structure; very firm and brittle, sticky and plastic; thick, continuous clay films; 50 percent shale fragments; medium acid; gradual, wavy boundary.

C—42 to 46 inches, reddish-brown (5YR 4/3) very shaly silty clay loam; common, medium, prominent, light reddish-brown (5YR 6/3) and yellowish-brown (10YR 5/6) mottles; weak, thick, platy structure; very firm, sticky and plastic; 80 percent shale fragments; many black concretions; medium acid; clear, wavy boundary.

R—46 inches +, weak-red (2.5YR 4/2) fractured shale bedrock.

The solum ranges from 36 to 55 inches in thickness. Bedrock is at a depth of 42 to 60 inches, and there is a fragipan at a depth of 15 to 27 inches. The content of coarse fragments in the A horizon ranges from less than 1 percent to 10 percent. The B horizon ranges from dark reddish gray to reddish brown that is distinctly or prominently mottled. It is silt loam, silty clay loam, or clay loam. The content of coarse fragments in the B horizon ranges from less than 2 percent, but the weighted average is 30 percent or less. The B horizon ranges from medium acid to very strongly acid. The content of coarse fragments in the C horizon is 60 to 90 percent of the soil mass. The C horizon ranges from strongly acid to slightly acid.

Abbottstown soils in Bucks and Philadelphia Counties lack the gleyed horizon at depths between 12 and 20 inches that is defined in the range for the series. This difference does not alter the use, management, or behavior of these soils.

Abbottstown soils are in close association on the landscape with well drained Penn and Klinesville soils, moderately well drained Readington soils, and poorly drained Doylestown soils. They are also associated with moderately well drained to somewhat poorly drained Reaville soils that are moderately deep to bedrock.

Abbottstown silt loam, 0 to 3 percent slopes (AbA).—This soil is at the base of slopes, along small drainageways, and on broad ridgetops (fig. 16). Areas are irregular in shape and 3 to 100 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are areas of similar soils that are yellowish brown. Also included are small areas of Doylestown soils and a few areas of moderately deep, somewhat poorly drained soils that formed in gray shale.

Most of this soil is used for crops. It is suited to moisture-tolerant field crops, grasses, and legumes. Alfalfa and winter grain are subject to damage from frost heaving.

The seasonal high water table and slow permeability are limitations to most nonfarm uses of this soil. Capability unit IIIw-1.

Abbottstown silt loam, 3 to 8 percent slopes (AbB).—This soil is on broad ridgetops and sides of ridges. Areas are generally elongated or irregular in shape and 3 to 100 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is slightly thinner.

Figure 16.—**Typical farmstead in an area of Abbottstown silt loam.**

Included with this soil in mapping are some areas of similar soils that are yellowish brown and some areas of eroded Abbottstown soils that are missing almost all of the original surface layer.

Most of this soil is used for crops and pasture. It is suited to moisture-tolerant field crops, grasses, and legumes. Alfalfa and winter grain are subject to damage from frost heaving.

The seasonal high water table and slow permeability are limitations to most nonfarm uses of this soil. Capability unit IIIw–1.

Abbottstown silt loam, 8 to 15 percent slopes (AbC).—This soil is on middle positions on the lower slopes. Areas are generally elongated and 4 to 20 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is slightly thinner and the upper part of the profile contains more shale fragments.

Included with this soil in mapping are some areas of similar soils that are yellowish brown. Also included are some areas of Doylestown soils.

Most of this soil is used for crops and pasture. It is suited to moisture-tolerant field crops, grasses, and legumes. Alfalfa and winter grain are subject to damage from frost heaving.

The hazard of erosion, seasonal high water table, and slow permeability are limitations to most nonfarm uses of this soil. Capability unit IIIe–6.

Allenwood Series

The Allenwood series consists of deep, well-drained, gently sloping to moderately steep soils on uplands. These soil are on side slopes and hilltops. Allenwood soils formed in loamy glacial till or frost-churned material derived from shale and sandstone.

In a representative profile in a wooded area, 2 inches of organic material covers the surface. The surface layer is 1 inch of yellowish-red gravelly silt loam, and the subsurface layer is about 10 inches of reddish-brown gravelly silt loam. The subsoil extends to a depth of about 46 inches. It is reddish-brown gravelly silt loam in the upper 7 inches; then 12 inches of reddish-brown gravelly silty clay loam over 9 inches of yellowish-red gravelly silty clay loam; and 7 inches of yellowish-red gravelly silt loam in the lower part. The subsoil is underlain to a depth of 50 inches by brown very gravelly silt loam.

Runoff is medium, and the hazard of erosion is moderate. Available moisture capacity is high, and permeability is moderate. The slope and the hazard of erosion are limitations to most nonfarm uses of these soils.

Representative profile of Allenwood gravelly silt loam, 8 to 15 percent slopes, in a wooded area near County Road 09057, in Durham Township:

O1—2 inches to 1 inch, undecomposed leaves and twigs.

O2—1 inch to 0, black partly decomposed organic matter and some silt; slightly acid; clear, wavy boundary.
A1—0 to 1 inch, yellowish-red (5YR 5/6) gravelly silt loam; weak, very fine, granular structure; friable; 25 percent gravel; clear, smooth boundary.
A2—1 to 11 inches, reddish-brown (5YR 4/4) gravelly silt loam; moderate, fine, granular structure; very friable; 20 percent gravel; very strongly acid; clear, wavy boundary.
B1—11 to 18 inches, reddish-brown (5YR 5/4) gravelly heavy silt loam; weak, fine, subangular blocky structure parting to moderate, fine, granular; very friable; 25 percent gravel; slightly sticky and slightly plastic; very strongly acid; clear, wavy boundary.
B21t—18 to 30 inches, reddish-brown (5YR 4/4) gravelly silty clay loam; moderate, medium, subangular blocky structure; slightly firm, slightly sticky and plastic; 25 percent gravel; thin clay films on ped faces; very strongly acid; clear, wavy boundary.
B22t—30 to 39 inches, yellowish-red (5YR 5/6) gravelly silty clay loam; weak, coarse, subangular blocky structure; slightly firm, sticky and plastic; 30 percent gravel; clay films on ped faces and lining old root channels and wormholes; very strongly acid; gradual, wavy boundary.
B23t—39 to 46 inches, yellowish-red (5YR 5/6) gravelly heavy silt loam; weak, coarse, subangular blocky structure; slightly firm, slightly sticky and slightly plastic; 35 percent gravel; clay films on ped faces; very strongly acid; clear, wavy boundary.
C—46 to 50 inches, brown (7.5YR 5/4) very gravelly silt loam; common, faint, light-brown (7.5YR 6/4) and yellowish-red (5YR 5/8) mottles; massive; firm, slightly plastic; 45 percent gravel; very strongly acid.

The solum ranges from 40 to 54 inches in thickness. Depth to bedrock ranges from 3½ to 10 feet. The content of coarse fragments in the A horizon ranges from 15 to 25 percent. The B horizon ranges from red to brown. It is heavy silt loam, clay loam, and silty clay loam. The content of coarse fragments in individual layers of the B horizon is 20 to 40 percent. Structure ranges from weak, fine, subangular blocky to moderate, coarse, subangular blocky. The C horizon is similar to the B horizon in color.

Allenwood soils are in close association with Readington and Doylestown soils but lack the fragipan characteristic of Readington and Doylestown soils. Allenwood soils also are better drained than those soils.

Allenwood gravelly silt loam, 3 to 8 percent slopes (AdB).—This soil is near the tops of slopes and on hilltops. Areas are irregular in shape and 4 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the subsoil is thicker.

Included with this soil in mapping are a few small areas of cobbly and very gravelly soils and areas of similar soils that have a firm, slowly permeable subsoil.

Most of this soil is used for crops and pasture, but a few small areas have reverted to woodland. It is suited to most cultivated crops commonly grown in the area. The quartzite gravel fragments in the surface layer cause excessive wear on tillage implements.

This soil has good drainage and gentle slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit IIe–3.

Allenwood gravelly silt loam, 8 to 15 percent slopes (AdC).—This soil is on hillsides. It is adjacent to steeper Allenwood soils or to very stony soils that are in woodland and pasture. Areas are elongated or irregular in shape and 4 to 25 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some areas of eroded Allenwood soils that are missing almost all of the original surface layer, some areas of similar soils that have a firm, slowly permeable subsoil, and some areas of cobbly and very gravelly soils.

Most of this soil is used for crops or pasture, but some areas are idle or have reverted to woodland. It is suited to most cultivated crops commonly grown in the area. The quartzite gravel fragments in the surface layer cause excessive wear on tillage implements.

The slope limits most nonfarm uses of this soil. Capability unit IIIe–2.

Allenwood gravelly silt loam, 15 to 25 percent slopes (AdD).—This soil is on hillsides. It is adjacent to very stony soils that are in woodland or pasture. Areas are elongated and 4 to 25 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the subsoil is thinner and the content of gravel is more.

Included with this soil in mapping are some areas of eroded Allenwood soils that are missing almost all of the original surface layer, some areas of similar soils that have a firm, slowly permeable subsoil, and some areas of cobbly and very gravelly soils.

Most of this soil is used for hay and pasture and is suited to this use. Some areas are idle or have reverted to woodland. The quartzite gravel fragments in the surface layer and a few stones interfere with tillage and and cause excessive wear on tillage implements.

The slope limits most nonfarm uses of this soil. Capability unit IVe–1.

Alluvial Land

Alluvial land (Ae) is on the flood plain of small streams. It consists of frequently flooded, somewhat poorly drained and poorly drained soils that formed in alluvium. The slope is less than 3 percent. Some areas are free of stones, but others have stones and boulders. Areas are commonly cut by shallow stream channels. They are very long and narrow and range from 5 to 25 acres in size. Included in mapping are some frequently flooded areas along the Delaware River.

Fair stands of moisture-tolerant trees are in some areas, but other areas are too stony, too wet, or too frequently flooded for tree growth. Alluvial land is much too wet for cultivation, but it is suited to wildlife habitat or esthetic uses.

Most nonfarm uses are limited by flooding and wetness. Capability unit VIIs–4.

Alton Series

The Alton series consists of deep, well-drained, nearly level to gently sloping soils on outwash terraces. These soils are in the Delaware River Valley (fig. 17). They formed in very gravelly outwash material derived from shale, sandstone, quartzite, and some limestone.

In a representative profile in a cultivated area, the plow layer is dark-brown gravelly loam about 8 inches thick. The subsoil is 24 inches thick. The upper 18 inches is brown very gravelly sandy loam; the lower 6 inches is brown very gravelly loamy sand. The substratum is

Figure 17.—Landscape of Alton gravelly loam, flooded, 0 to 5 percent slopes, along the Delaware River. Gravel fragments are in foreground.

strong-brown stratified sand and gravel to a depth of 60 inches or more.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. The available water capacity is low, and permeability is rapid. Coarse fragments and low available water capacity are limitations to most nonfarm uses of these soils.

Representative profile of Alton gravelly loam, 0 to 3 percent slopes, in a cultivated field 50 feet east of Tyburn Road, 1½ miles south of Morrisville, in Falls Township:

Ap—0 to 8 inches, dark-brown (7.5YR 3/2) gravelly loam; weak, very fine, granular structure; very friable; 25 percent gravel; strongly acid; abrupt, smooth boundary.

B2—8 to 26 inches, brown (7.5YR 4/4) very gravelly sandy loam; weak, medium, subangular blocky structure and lenses of thick, platy structure; friable; few thin silt films; 55 percent gravel; medium acid; clear, wavy boundary.

B3—26 to 32 inches, brown (7.5YR 4/4) very gravelly loamy sand; weak, coarse, subangular blocky structure; very friable; 60 percent gravel; medium acid; clear, wavy boundary.

IIC—32 to 60 inches, strong-brown (7.5YR 5/6) stratified sand and gravel; medium acid.

The solum ranges from 24 to 40 inches in thickness. Depth to bedrock ranges from 4 to 100 feet or more. The B horizon ranges from dark brown to reddish brown. It is very gravelly loam or sandy loam in the upper part and very gravelly sandy loam or loamy sand below a depth of 20 inches. Coatings of carbonates are on some gravel below a depth of 48 inches. Alton soils in Bucks and Philadelphia Counties have a thinner solum than the defined range for the series, but the thinner solum does not alter the use, management, or behavior of these soils.

Alton soils are in close association with Pope soils on the flood plains and with Howell soils on the Coastal Plain. Alton soils have more gravel than Pope soils and less clay than Howell soils.

Alton gravelly loam, 0 to 3 percent slopes (AgA).—This soil is on broad terraces in the Delaware River Valley. Areas are elongated and are 4 to 50 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some areas of Pope soils and a few small areas of soils that have a more clayey subsoil.

Most areas of this soil are used for crops. Some areas of this soil are idle and are designated for urban development. This soil is droughty but is suited to most crops commonly grown in the area.

This soil has good drainage and is nearly level; therefore it is only slightly limited for most nonfarm uses. Capability unit IIIs-1.

Alton gravelly loam, 3 to 8 percent slopes (AgB).—This soil is on terraces in the Delaware River Valley. Areas

are elongated and 4 to 50 acres in size. The profile of this soil is similar to the one described as representative of the series, but the subsoil is slightly thinner.

Included with this soil in mapping are some soils that have a more clayey subsoil and a few areas of sloping Alton soils.

Most areas of this soil are used for crops. Some areas are idle and are designated for urban development. This soil is droughty, but it is suited to most crops commonly grown in the area.

This soil has good drainage and gentle slopes and therefore is only slightly limited for most nonfarm uses. Capability unit IIIs-1.

Alton gravelly loam, flooded, 0 to 5 percent slopes (AlA).—This soil is on high-lying flood plains along the Delaware River. Areas are elongated and 4 to 25 acres in size.

Included with this soil in mapping are some areas of Pope soils, a few small areas of soils that have a more clayey subsoil, and some areas of similar soils that are more alkaline.

Most areas of this soil are used for crops. Some areas have been used for housing developments. This soil is suited to most crops commonly grown in the area. It is droughty but is subject to flooding during intense rain.

The hazard of flooding limits most nonfarm uses of this soil. Capability unit IIIw-4.

Bedington Series

The Bedington series consists of deep, well-drained, nearly level to sloping soils on uplands. These soils are on convex sides of ridges and ridgetops. They formed in loamy material weathered chiefly from brown, gray, and yellowish-brown shale.

In a representative profile in a cultivated area, the plow layer is dark yellowish-brown silt loam about 13 inches thick. The subsoil is 57 inches thick. The upper 12 inches is brown silt loam; the next 26 inches is strong-brown and brown shaly silt loam; the lower 19 inches is dark-brown very shaly silt loam and very shaly loam. Fractured shale bedrock is at a depth of 70 inches.

Runoff is medium, and the hazard of erosion is slight to moderate. Available water capacity is high, and permeability is moderate. The slope and the hazard of erosion are limitations to most nonfarm uses of these soils.

Representative profile of Bedington silt loam, 3 to 8 percent slopes, in a cultivated field 3 miles south of Doylestown. This is the soil S68Pa-09-9(1-6) sampled for characterization analysis in tables 12 and 13:

Ap—0 to 13 inches, dark yellowish-brown (10YR 3/4) silt loam; weak, fine, granular structure; friable, slightly plastic; 5 percent soft shale fragments; medium acid; abrupt, smooth boundary.

B21t—13 to 25 inches, brown (7.5YR 4/4) heavy silt loam; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; friable, slightly sticky; thin silt and clay films on peds; 5 percent soft shale fragments; neutral; gradual, wavy boundary.

B22t—25 to 38 inches, strong-brown (7.5YR 5/6) heavy shaly silt loam; weak, very coarse, prismatic structure parting to weak, coarse, subangular blocky; firm, slightly sticky and plastic; few thin clay films on peds; some black iron and manganese coatings; 20 percent soft shale fragments; neutral; gradual, wavy boundary.

B23t—38 to 51 inches, brown (7.5YR 4/4) shaly silt loam; weak, coarse, subangular blocky structure; firm, sticky and plastic; thick clay films in pores, thin clay films on peds; some black iron and manganese coatings; 40 percent soft shale fragments; strongly acid; gradual, wavy boundary.

B24t—51 to 57 inches, dark-brown (7.5YR 4/4) very shaly silt loam; weak, coarse, subangular blocky structure; firm, sticky and plastic; thick clay films in pores, thin clay films on peds; many black iron and manganese coatings; 50 percent shale fragments; strongly acid; gradual, wavy boundary.

B3—57 to 70 inches, dark-brown (7.5YR 4/4) very shaly loam; moderate, thick, platy structure parting to weak, fine, subangular blocky; firm, sticky and slightly plastic; thin clay films on coarse fragments; many black iron and manganese coatings; 60 percent soft shale fragments; strongly acid; abrupt, wavy boundary.

R—70 inches +, yellowish-brown (10YR 5/), fractured shale bedrock; strongly acid.

The solum ranges from 42 to 70 inches in thickness. Depth to bedrock ranges from 50 to 75 inches. The B horizon ranges from dark brown to strong brown. It is heavy silt loam, silty clay loam, and heavy loam. The content of coarse fragments in individual layers of the B horizon ranges from 5 to 60 percent, but it averages less than 35 percent in the top 20 inches of the Bt horizon. Some profiles have a thin, very shaly C horizon overlying fractured shale bedrock.

Bedington soils are in close association with well-drained Culleoka and Weikert soils but are deeper than those soils. They also are near moderately well drained Readington soils, somewhat poorly drained Abbottstown soils, and poorly drained Doylestown soils but differ from those soils in not having a fragipan.

Bedington silt loam, 0 to 3 percent slopes (BeA).—This soil is on broad ridgetops. Areas are oval or elongated and range from 3 to 50 acres in size.

Included with this soil in mapping are small areas of Readington, Culleoka, and Weikert soils.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area.

This soil has good drainage and uniform, nearly level slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit I-2.

Bedington silt loam, 3 to 8 percent slopes (BeB).—This soil is on convex mid and upper slopes of hills and ridges. Areas are elongated or irregular in shape and range from 3 to 100 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are small areas of Readington, Culleoka, and Weikert soils.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area. The hazard of erosion is the main limitation to farming.

This soil has good drainage and gentle slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit IIe-2.

Bedington silt loam, 8 to 15 percent slopes (BeC).—This sloping soil is on convex sides of hills and ridges. Areas generally are elongated and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the subsoil is slightly thinner.

Included with this soil in mapping are a few small areas of Culleoka and Weikert soils.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area. The hazard of erosion is the main limitation to farming.

The slope limits most nonfarm uses of this soil. Capability unit IIIe-1.

Bowmansville Series

The Bowmansville series consists of deep, poorly drained, nearly level soils on the flood plain (fig. 18). Most areas are along small meandering streams. These soils formed in loamy alluvium that washed from upland soils underlain by red and brown shale and sandstone.

In a representative profile in an area of pasture, the plow layer is dark-brown silt loam about 8 inches thick. The subsoil is 23 inches thick. The upper 10 inches is reddish-brown silt loam that has reddish-yellow and pinkish-gray mottles. The lower 13 inches is reddish-gray and dark reddish-gray heavy silt loam that has strong-brown and pinkish-gray mottles. The upper part of the substratum is pinkish-gray silt loam that has reddish-yellow mottles and extends to a depth of 50 inches. The lower part is stratified sand and gravel.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is high, and permeability is moderately slow. Flooding normally occurs annually late in winter and spring. Flooding, restricted permeability, and wetness are limitations to nonfarm use of these soils.

Representative profile of Bowmansville silt loam, in a pasture south of Pine Run Creek, 175 feet northeast of Limekiln Road, Doylestown Township.

Ap—0 to 8 inches, dark-brown (7.5YR 4/2) silt loam; common reddish-yellow (7.5YR 6/6) stains around root channels; weak, very fine, granular structure; friable; medium acid; abrupt, smooth boundary.

B1—8 to 12 inches, reddish-brown (5YR 5/3) silt loam; many, coarse, distinct, reddish-yellow (5YR 6/6) mottles; weak, fine, subangular blocky structure; friable; thin, discontinuous silt films on faces of peds; medium acid; clear, wavy boundary.

B21—12 to 18 inches, reddish-brown (5YR 5/4) silt loam; many, medium, faint, pinkish-gray (7.5YR 6/2) mottles; weak, medium, subangular blocky structure; friable; faint silt films on peds and in pores; medium acid; clear, smooth boundary.

B22g—18 to 24 inches, reddish-gray (5YR 5/2) heavy silt loam; many, coarse, faint, strong-brown (7.5YR 5/6) mottles; weak, medium, prismatic structure parting to weak, medium, subangular blocky; friable, slightly sticky and plastic; silt films in pores; medium acid; clear, smooth boundary.

B23g—24 to 31 inches, dark reddish-gray (5YR 4/2) heavy silt loam; many, coarse, distinct, strong-brown (7.5YR 5/6) and pinkish-gray (7.5YR 6/2) mottles; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; firm, sticky and plastic; silt and clay films in pores; medium acid; abrupt, smooth boundary.

C1g—31 to 50 inches, pinkish-gray (5YR 6/2) silt loam; many, medium, distinct, reddish-yellow (7.5YR 6/6) mottles; massive; firm; medium acid.

IIC2—50 to 55 inches, stratified sand and gravel; medium acid.

The solum ranges from 30 to 40 inches in thickness. Depth to hard rock ranges from 3½ to 12 feet. The content of subrounded coarse fragments of shale or sandstone ranges

Figure 18.—Pond in an area of Bowmansville silt loam that was formerly used for pasture.

from 0 to 10 percent in the solum and from 0 to 30 percent in the C1g horizon. The B horizon ranges from weak red to reddish brown and has gray, reddish-gray, reddish-yellow, or strong-brown mottles. The B horizon is mainly silt loam or silty clay loam but ranges to sandy clay loam. The B2 horizon ranges from weak, medium, subangular blocky structure to weak, coarse, prismatic. The B horizon ranges from strongly acid to slightly acid. The C horizon is silt loam, silty clay loam, or sandy loam and is stratified sand and gravel at a depth below 40 inches.

Bowmansville soils are in close association with Rowland soils on the flood plain and are more poorly drained than those soils.

Bowmansville silt loam (0 to 5 percent slopes) (Bo).—This is the dominant soil on the flood plains along creeks in areas of shale and sandstone. Areas are long and narrow and 3 to 50 acres in size.

Included with this soil in mapping are some small areas of similar flood plain soils that are well drained. Also included are some areas of soils that were cut and gouged by swift-flowing water.

Most of this soil is used for pasture or is idle. On a few of the wider areas on flood plains the soil is used for crops.

Flooding, the high water table, and moderately slow permeability are limitations to the nonfarm uses of this soil. Capability unit IVw-1.

Chalfont Series

The Chalfont series consists of deep, somewhat poorly drained, nearly level to gently sloping soils on uplands. These soils occupy concave positions on the landscape. They formed in a silty, windblown mantle that overlies loamy material weathered from red and brown shale and sandstone.

In a representative profile in a cultivated area, the plow layer is brown silt loam about 10 inches thick. The subsoil is 47 inches thick. The upper 11 inches is brown silt loam and silty clay loam that has light brownish-gray and strong-brown mottles. The next 12 inches is compact, firm and brittle, dark yellowish-brown and grayish-brown silt loam that has many mottles. The lower 24 inches is firm and brittle, dark-brown and brown, mottled shaly silt loam. The substratum, to a depth of 70 inches, is brown shaly silt loam that has many brown and strong-brown mottles.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. Available water capacity is moderate, and permeability is slow. The water table generally rises to within 6 to 18 inches of the surface during wet seasons. Restricted permeability and wetness are limitations to most nonfarm uses of these soils.

Representative profile of Chalfont silt loam, 0 to 3 percent slopes, in a cultivated field 1 mile east of Edison, about 693 feet east of Pebble Hill Road. This is the soil S68Pa-09-6(1-8) sampled for characterization analysis in tables 12 and 13:

Ap—0 to 10 inches, brown (10YR 4/3) silt loam; weak, medium, granular structure; friable, slightly sticky and slightly plastic; medium acid; clear, wavy boundary.

B21t—10 to 14 inches, brown (7.5YR 5/4) silt loam; many, fine, distinct, strong-brown (7.5YR 5/6) and light brownish-gray (10YR 6/2) mottles; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; common patches of silt and clay films on faces of peds; medium acid; clear, wavy boundary.

B22t—14 to 21 inches, brown (7.5YR 4/4) light silty clay loam; many, fine and medium, distinct, light brownish-gray (10YR 6/2) and strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable, slightly sticky and plastic; common silt and clay films on faces of peds; few black iron and manganese coatings; slightly acid; clear, wavy boundary.

Bx1—21 to 27 inches, dark yellowish-brown (10YR 4/4) silt loam; light-gray (10YR 7/1) prism faces; common, fine, distinct, strong-brown (7.5YR 5/6) and brown (10YR 5/3) mottles; weak, very coarse, prismatic structure parting to weak, thin, platy; firm and brittle, slightly sticky and slightly plastic; few thin clay films in pores; few fragments of shale; neutral; clear, wavy boundary.

Bx2g—27 to 33 inches, grayish-brown (10YR 5/2) silt loam; light-gray (10YR 7/1) prism faces; many, medium, distinct, brown (7.5YR 5/4) and light brownish-gray (10YR 6/2) mottles; moderate, very coarse, prismatic structure parting to thin, platy; firm and brittle, slightly sticky and slightly plastic; few fragments of shale; neutral; abrupt, wavy boundary.

IIBx3—33 to 47 inches, dark-brown (7.5YR 4/5) shaly silt loam; light-gray (10YR 7/1) prism faces; many, medium, faint, brown (7.5YR 5/4) mottles; weak, very coarse, prismatic structure parting to weak, medium, subangular blocky; firm and brittle, slightly sticky and slightly plastic; many black coatings; 45 percent shale; neutral; gradual, wavy boundary.

IIBx4—47 to 57 inches, brown (7.5YR 4/4) shaly silt loam; light-gray (10YR 7/1) prism faces; many, medium, faint, brown (7.5YR 5/2) and strong-brown (7.5YR 5/6) mottles; weak, very coarse, prismatic structure parting to weak, medium, subangular blocky; very firm and brittle, sticky and plastic; many black coatings; 20 percent shale; neutral; gradual, wavy boundary.

IIC—57 to 70 inches, brown (7.5YR 4/4) shaly silt loam; light-gray (10YR 7/1) prism faces; many, medium, faint, brown (7.5YR 5/2) and strong-brown (7.5YR 5/6) mottles; weak, very coarse, prismatic structure; firm, sticky and slightly plastic; 40 percent shale; neutral.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock ranges from 4 to 8 feet. Depth to fragipan ranges from 15 to 25 inches. The silty mantle ranges from 30 to 60 inches in thickness. The Bt horizon ranges from dark yellowish brown to strong brown, and grayish mottles occur within the upper 10 inches. The B horizon is silt loam or silty clay loam. Structure ranges from moderate, fine, subangular blocky above the fragipan to moderate, very coarse, prismatic and thick and platy in the fragipan. The B horizon is neutral to strongly acid. The content of coarse fragments in the IIB and IIC horizons ranges from 15 to 50 percent.

The somewhat poorly drained Chalfont soils are in a drainage pattern with well drained Duncannon soils, moderately well drained Lawrenceville soils, and poorly drained Doylestown soils. The Chalfont soils are on the landscape near Penn, Lansdale, Readington, and Abbottstown soils. These nearby soils have more reddish hues inherited from the parent material and generally contain more coarse fragments in the upper part of their profiles than Chalfont soils.

Chalfont silt loam, 0 to 3 percent slopes (CaA).—This soil is at the bases of slopes and in slight depressions (fig. 19). Areas are irregular in shape and 3 to 15 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some areas of Abbottstown soils and small areas of Doylestown and Lawrenceville soils.

Figure 19.—Typical landscape of Chalfont and Doylestown soils. Chalfont silt loam, 0 to 3 percent slopes, is in foreground; Doylestown silt loam, 0 to 3 percent slopes, is in front of trees in background.

Most of this soil is used for crops. It is suited to water-tolerant crops. This soil is in demand for various nonfarm uses because of its desirable location.

The seasonal high water table and slow permeability limit most nonfarm uses of this soil. Capability unit IIIw–1.

Chalfont silt loam, 3 to 8 percent slopes (CaB).—This soil is on broad areas above drainageways. Areas are irregular in shape and 3 to 15 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but it contains a few more coarse fragments and the surface layer is slightly thinner.

Included with this soil in mapping are small areas of Abbottstown soils and a few small areas of Lawrenceville and Doylestown soils.

Most of this soil is used for crops. It is suited to water-tolerant crops.

Gentle slopes and a desirable location result in various nonfarm uses of this soil, but the seasonal high water table and slow permeability limit most such uses. Capability unit IIIw–1.

Chester Series

The Chester series consists of deep, well-drained, nearly level to very steep soils on uplands. These soils are on sides and tops of ridges. They formed in loamy material weathered chiefly from gneiss and schist.

In a representative profile in a wooded area, 2 inches of organic matter cover the surface. The surface layer is very dark gray loam about 4 inches thick; the subsurface layer is dark-brown loam about 4 inches thick. The subsoil is 37 inches thick. The upper 27 inches is strong-brown channery loam and channery clay loam; the lower 10 inches is yellowish-red channery loam. The substratum is yellowish-red channery loam to a depth of 60 inches.

Runoff is slow to rapid, and the hazard of erosion is slight to high. Available water capacity is moderate to high, and permeability is moderate. The slope and stoniness are limitations to most nonfarm uses of these soils.

Representative profile of Chester loam in a wooded area of Chester extremely stony loam, 8 to 25 percent slopes, 40 feet northeast of road T420, in Springfield Township:

O—2 inches to 0, mixture of leaves, twigs, and partly decomposed organic matter.

A1—0 to 4 inches, very dark gray (10YR 3/1) loam; weak, very fine, granular structure; friable; 10 percent coarse fragments; neutral; abrupt, wavy boundary.

A2—4 to 8 inches, dark-brown (10YR 4/3) loam; weak, fine, granular structure; friable; 10 percent coarse fragments; neutral; abrupt, wavy boundary.

B1—8 to 12 inches, strong-brown (7.5YR 5/6) channery loam; weak, fine, subangular blocky structure; friable, slightly sticky; 25 percent coarse fragments; slightly acid; clear, wavy boundary.

B21t—12 to 29 inches, strong-brown (7.5YR 5/6) channery heavy loam; weak, medium, subangular blocky structure; friable, slightly sticky; clay films on peds; 30 percent coarse fragments; medium acid; clear, wavy boundary.

B22t—29 to 35 inches, strong-brown (7.5YR 5/6) channery light clay loam; weak, very thick, platy structure; friable, slightly sticky and slightly plastic; thin continuous clay films on peds; 30 percent coarse fragments; strongly acid; clear, wavy boundary.

B3—35 to 45 inches, yellowish-red (5YR 5/6) channery heavy loam; weak, thick, platy structure; friable, slightly sticky; 35 percent coarse fragments; strongly acid; gradual, wavy boundary.

C—45 to 60 inches, yellowish-red (5YR 5/6) channery loam; variegated layers of reddish yellow (7.5YR 6/6); massive; friable; 40 percent coarse fragments; strongly acid.

The solum ranges from 30 to 50 inches in thickness. Depth to bedrock ranges from 5 to 10 feet. The content of coarse fragments in the A and B2t horizons ranges from 0 to 30 percent and increases with increasing depth. The B horizon ranges from yellowish brown to yellowish red. It is loam, clay loam, and silty clay loam. Mica content in the B horizon generally increases with increasing depth.

Chester soils are in close association with Manor and Urbana soils. They have a thicker solum than Manor soils and are better drained than Urbana soils.

Chester silt loam, 0 to 3 percent slopes (CeA).—This soil is on hilltops. Areas are elongated or irregular in shape and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, except that the solum is thicker and the content of coarse fragments is less.

Included with this soil in mapping are some similar soils that formed in material weathered from quartzite gneiss. Also included are small areas of Urbana, Duncannon, and Lawrenceville soils.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area.

This soil has good drainage and nearly level slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit I–2.

Chester silt loam, 3 to 8 percent slopes (CeB).—This soil is on sides and tops of ridges. Areas are elongated or irregular in shape and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the content of coarse fragments is less.

Included with this soil in mapping are some areas of soils that have a thinner subsoil and some that contain more quartzite fragments. Also included are some small areas of very stony Chester soils. These areas are indicated on the detailed soil map by a stone symbol. Also included are a few small areas of eroded Chester soils that are missing most of the original surface layer.

Most of this soil is used for crops and pasture. It is suited to most cultivated crops commonly grown in the area.

This soil has good drainage and gentle slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit IIe–2.

Chester silt loam, 8 to 15 percent slopes (CeC).—This soil is on the sides of ridges. Areas are elongated and 3 to 50 acres or more in size.

Included with this soil in mapping are some areas of soils that formed in material weathered from quartzite gneiss. Also included are some areas of soils that have a thinner subsoil and some areas of eroded Chester soils that are missing most of the original surface layer.

Most of this soil is used for crops and pasture. It is suited to most cultivated crops commonly grown in the area.

The slope limits most nonfarm uses of this soil. Capability unit IIIe–1.

Chester silt loam, 15 to 25 percent slopes (CeD).—This soil is on sides of ridges. Areas are irregular in shape and 3 to 20 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsoil are thinner and the content of coarse fragments is greater.

Included with this soil in mapping are some areas of similar soils that are moderately deep, are more gravelly, and contain more quartzite fragments.

Most of this soil is used for hay and pasture. It is suited to long-term hay crops, orchard crops, or pasture.

The slope limits most nonfarm uses of this soil. Capability unit IVe–1.

Chester extremely stony loam, 8 to 25 percent slopes (ChD).—This soil dominantly is on sides of hills and ridges. Areas are elongated or irregular in shape and 4 to 100 acres or more in size. The profile of this soil is the one described as representative of the Chester series. Stones and boulders are on about 5 to 25 percent of the surface layer.

Included with this soil in mapping are some areas of very stony Chester soils. Also included are some areas of very stony soils that are moderately deep and some areas of very stony soils that contain many quartzite fragments.

Most of this soil is used as woodland. It is not suited to cultivation because of the extremely stony surface layer.

The slope and stoniness limit most nonfarm uses of this soil. Capability unit VIIs–1.

Clarksburg Series

The Clarksburg series consists of deep, moderately well drained, gently sloping soils on uplands. These soils are at the base of slopes. They formed in loamy material weathered chiefly from limestone.

In a representative profile in a cultivated area, the plow layer is very dark grayish-brown silt loam about 10 inches thick. The subsoil is 52 inches thick. The upper 22 inches is strong-brown clay loam that has distinct, light-gray and light-brown mottles at a depth below 26 inches. The lower 30 inches is compact, firm and brittle, strong-brown silt loam and silty clay loam; it has a thick platy structure and many, light-gray and reddish-brown mottles.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is moderate, and permeability is slow. The water table generally rises to within 18 to 36 inches of the surface during wet seasons. Restricted permeability and wetness are limitations to most nonfarm uses of these soils.

Representative profile of Clarksburg silt loam, 2 to 6 percent slopes, in a cultivated field 350 feet south of Funk Mill Road, in Durham Township:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, very fine, subangular blocky structure; friable; 2 percent coarse fragments; slightly acid; abrupt, smooth boundary.

B21t—10 to 21 inches, strong-brown (7.5YR 5/6) light clay loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; few patches of clay films on peds; material from Ap horizon in root channels and wormholes; neutral; clear, wavy boundary.

B22t—21 to 26 inches, strong-brown (7.5YR 5/8) clay loam; many, fine, faint, pink (7.5YR 7/4) and light yellowish-brown (10YR 6/4) mottles; moderate, coarse, subangular blocky structure; friable, slightly sticky and slightly plastic; thin, discontinuous clay films on peds; medium acid; clear, wavy boundary.

B23t—26 to 32 inches, strong-brown (7.5YR 5/6) clay loam; common, coarse, distinct, light-gray (10YR 7/2) and light-brown (7.5YR 6/4) mottles; moderate, thick, platy structure; friable, slightly sticky and slightly plastic; thick clay films in pores; medium acid; clear, wavy boundary.

Bx1—32 to 40 inches, strong-brown (7.5YR 5/6) silt loam; many, coarse, prominent, light-gray (10YR 7/1) and reddish-brown (5YR 5/4) mottles; weak, thick, platy structure; firm and brittle, slightly sticky and slightly plastic; 5 percent coarse fragments; medium acid; gradual, wavy boundary.

Bx2—40 to 62 inches, strong-brown (7.5YR 5/6) silty clay loam; many, coarse, prominent light-gray (10YR 7/1) and reddish-brown (5YR 5/4) mottles; weak, thick, platy structure; firm and brittle, slightly sticky and slightly plastic; 5 percent coarse fragments; medium acid.

The solum ranges from 40 to 70 inches in thickness. Depth to the fragipan ranges from 20 to 36 inches. Depth to bedrock is more than 5 feet. The content of quartz, schist, and other coarse fragments ranges from 0 to 10 percent in the upper part of the solum and from 5 to 15 percent in the fragipan. The B horizon is brown, strong brown, and yellowish brown. It is generally clay loam and silty clay loam, but some subhorizons are loam or silt loam. Low-chroma mottling begins at a depth below 20 inches. The B horizon is medium acid or slightly acid unless limed.

Clarksburg soils are in close association with well-drained Duffield and Washington soils. All these soils formed in similar parent material.

Clarksburg silt loam, 2 to 6 percent slopes (ClB).—This soil is at the base of slopes and in slightly depressional positions. Areas are elongated or irregular in shape and 3 to 20 acres in size.

Included with this soil in mapping are some areas of similar soils that are not so well drained.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area. Most deep-rooted plants are subject to damage from frost heaving.

The seasonal high water table and slow permeability limit most nonfarm uses of this soil. Capability unit IIe-5.

Culleoka Series

The Culleoka series consists of moderately deep, well-drained, gently sloping to moderately steep soils on uplands. These soils are on mid and upper sides of ridges. They formed in loamy material weathered in yellow and gray shales. They contain many coarse fragments.

In a representative profile in a cultivated area, the plow layer is dark-brown shaly silt loam about 8 inches thick. The subsoil is yellowish-brown shaly silty clay loam 16 inches thick. The substratum is firm, yellowish-brown very shaly silty clay loam 4 inches thick and overlies fractured argillite shale bedrock.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is low, and permeability is moderately rapid. The depth to bedrock and slope are limitations to most nonfarm uses of these soils.

Representative profile of Culleoka shaly silt loam, in an area of Culleoka-Weikert shaly silt loams, 8 to 15 percent slopes, in a hayfield 1 mile east of New Galena:

Ap—0 to 8 inches, dark-brown (7.5YR 3/2) shaly silt loam; moderate, very fine, granular structure; friable; 30 percent shale fragments; slightly acid; abrupt, smooth boundary.

B2t—8 to 24 inches, yellowish-brown (10YR 5/4) shaly silty clay loam; moderate, medium, subangular blocky structure; firm, sticky and plastic; thin, continuous clay films on ped faces; 25 percent shale fragments; strongly acid; clear, wavy boundary.

C—24 to 28 inches, yellowish-brown (10YR 5/4) very shaly silty clay loam; massive; firm, sticky and plastic; 75 percent shale fragments; medium acid.

R—28 inches +, argillite shale bedrock.

The solum ranges from 20 to 34 inches in thickness. Depth to bedrock ranges from 24 to 40 inches. The content of coarse fragments ranges from 15 to 35 percent in the A horizon, from 20 to 35 percent in the B horizon, and from 50 to 75 percent in the C horizon. Reaction is medium acid or strongly acid in the B horizon and slightly acid to strongly acid in the C horizon. The B horizon ranges from yellowish brown to brown, and it is silt loam or silty clay loam.

Culleoka soils are in close association with well-drained Bedington and Weikert soils. Culleoka soils are not so deep as Bedington soils, but they are deeper to bedrock than Weikert soils. Culleoka soils also are associated with the Abbottstown, Doylestown, Penn, and Readington soils that formed in redder material and, except for Penn soils, have a fragipan and a mottled B horizon.

Culleoka-Weikert shaly silt loams, 3 to 8 percent slopes (CwB).—This complex is 60 percent Culleoka soils, 35 percent Weikert soils, and 5 percent included soils. These soils are on sides and tops of ridges. Areas are irregular in shape and 4 to 50 acres or more in size. The profiles of these soils are similar to those described as representative of their respective series, but the surface layer and subsoil are thicker in the Culleoka soils and the content of coarse fragments is less in the Weikert soils.

Included with these soils in mapping are some small areas of moderately deep and shallow soils that formed in similar material and are moderately well drained. Also included are some areas of eroded Culleoka and Weikert soils that are missing almost all of the original surface layer.

These soils are mostly used for crops, but droughtiness limits their use for cultivated crops.

The depth to bedrock limits most nonfarm uses of these soils. Capability unit IIIe-4.

Culleoka-Weikert shaly silt loams, 8 to 15 percent slopes (CwC).—This complex is about 55 percent Culleoka soils, 40 percent Weikert soils, and 5 percent included soils. These soils are on hillsides and ridges. Areas are irregular or elongated in shape and 4 to 50 acres or more

in size. The profiles of these soils are the ones described as representative of their respective series.

Included with these soils in mapping are some areas of shallow and moderately deep soils that formed in similar material and are wet. Also included are some areas of Culleoka and Weikert soils that are missing almost all of the original surface layer.

These soils are mostly used for crops, but droughtiness limits their use for cultivated crops.

The depth to bedrock limits most nonfarm uses of these soils. Capability unit IVe-3.

Doylestown Series

The Doylestown series consists of deep, poorly drained, nearly level to gently sloping soils on uplands. These soils are on broad upland flats, in depressions, and at the base of slopes. They formed in silty material, chiefly windblown deposits, that overlie a variety of loamy materials generally weathered from shale and sandstone.

In a representative profile in a cultivated area, the plow layer is dark grayish-brown silt loam about 11 inches thick. The subsoil is 42 inches thick. The upper 9 inches is grayish-brown silty clay loam that has light brownish-gray and strong-brown mottles. It is firm and has prismatic structure (fig. 20). The lower 33 inches is firm, dense, and brittle, strong-brown, dark-brown, and brown silty clay loam and silt loam. It has prismatic and platy structure and has many, light brownish-gray and strong-brown mottles. Fractured shale bedrock is at a depth below 53 inches.

Figure 20.—**Typical prismatic structure of Doylestown silt loam. White lines are silt and clay coatings on faces of very coarse prisms.**

Runoff is slow to medium, and the hazard of erosion is slight to moderate. Available water capacity is moderate, and permeability is slow. The surface layer is ponded at times, and the water table is at or very near the surface during wet seasons. Restricted permeability and wetness are limitations to most nonfarm uses of these soils.

Representative profile of Doylestown silt loam, 0 to 3 percent slopes, in a cultivated field 3 miles south of Doylestown. This is the soil S68Pa-09-8(1-7) sampled for characterization analysis in tables 12 and 13:

Ap—0 to 11 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable, slightly sticky and slightly plastic; medium acid; abrupt, smooth boundary.

B2tg—11 to 20 inches, grayish-brown (10YR 5/2) silty clay loam; common, medium, prominent, light brownish-gray (2.5YR 6/2) and strong-brown (7.5YR 5/8) mottles; weak, coarse, prismatic structure; firm, sticky and plastic; thin clay films on ped faces; strongly acid; abrupt, smooth boundary.

Bx1g—20 to 25 inches, strong-brown (7.5YR 5/6) silty clay loam; light brownish-gray (2.5YR 6/2) prism faces; ped interiors have many, medium, faint, strong-brown (7.5YR 5/8) mottles; weak, very coarse, prismatic structure parting to medium, platy; firm, slightly sticky and plastic; thin clay films on plates; medium acid; clear, wavy boundary.

Bx2g—25 to 32 inches, dark-brown (7.5YR 4/4) silt loam; light brownish-gray (10YR 6/2) prism faces; ped interiors have many, medium, faint, strong-brown (7.5YR 5/6) mottles; weak, very coarse, prismatic structure parting to moderate, thin, platy; firm and brittle, slightly sticky and slightly plastic; thick continuous clay films; medium acid; clear, wavy boundary.

Bx3g—32 to 38 inches, brown (7.5YR 5/4) silt loam; light brownish-gray (10YR 6/2) prism faces; ped interiors have many, medium, faint, strong-brown (7.5YR 5/6) mottles; weak, very coarse, prismatic structure parting to thick, platy; firm, slightly sticky and plastic; 5 percent shale fragments; thin discontinuous clay films; medium acid; gradual, wavy boundary.

Bx4g—38 to 45 inches, brown (7.5YR 5/4) silt loam; light brownish-gray (10YR 6/2) prism faces; ped interiors have many, medium, faint, strong-brown (7.5YR 5/6) mottles; weak, very coarse, prismatic structure parting to thick, platy; firm, slightly sticky and slightly plastic; 5 percent shale fragments; thin discontinuous clay films; medium acid; gradual, wavy boundary.

Bx5g—45 to 53 inches, brown (7.5YR 5/4) silt loam; light brownish-gray (10YR 6/2) prism faces; ped interiors have many, medium, faint, strong-brown (7.5YR 5/6) mottles; weak, very coarse, prismatic structure parting to weak, thick, platy; firm, slightly sticky slightly plastic; thin, discontinuous clay films; medium acid; abrupt, wavy boundary.

IIR—53 inches +, dark-brown (10YR 3/3), fractured shale bedrock and black (10YR 2/1) coatings on rock fragments.

The solum ranges from 40 to 60 inches in thickness. Depth of the silt mantle ranges from 3 to 5 feet. Depth to the fragipan ranges from 15 to 25 inches. Depth to bedrock ranges from 4 to 7 feet. The content of coarse fragments is less than 5 percent in the upper part of the solum and ranges from 5 to 20 percent in the lower horizons. The B horizon ranges from light brownish gray to strong brown. It is silt loam, silty clay loam, and clay loam. Low-chroma mottling begins in the B horizon. The B horizon is slightly acid to strongly acid.

Doylestown soils in Bucks and Philadelphia Counties contain slightly more clay than the defined range for the series, but this difference does not alter the use, management, or behavior of these soils.

Doylestown soils are in close association with well-drained Duncannon soils, moderately well drained Lawrenceville soils, and somewhat poorly drained Chalfont soils that formed in similar material. Doylestown soils are also associated with the more reddish soils of the Penn, Readington, and Abbottstown series. Doylestown soils are finer textured than well-drained Lansdale soils that are in the same area.

Doylestown silt loam, 0 to 3 percent slopes (DoA).—This soil is in concave positions along drainageways, at the base of slopes, and on some broad ridgetops. Areas are elongated or irregular in shape and 3 to 150 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some similar soils that are moderately deep and some that contain more than 10 percent coarse fragments in the surface layer and subsoil. Also included are small areas of Bowmansville soils along short intermittent streams and some small areas of Reaville soils.

Most of this soil is used for hay or pasture. A few large areas are used for corn and soybeans. This soil generally is wet, and local flooding occurs in depressional areas. It is poorly suited to crops. It is suited to water-tolerant pasture, grasses, and trees.

The high water table and slow permeability limit most nonfarm uses of this soil. Capability unit IVw–2.

Doylestown silt loam, 3 to 8 percent slopes (DoB).—This soil is on middle and lower positions on slopes. Areas generally are elongated or irregular in shape and 3 to 150 acres or more in size. The profile of this soil is similar to the one described as representative of the Doylestown series, except that the solum is slightly thinner.

Included with this soil in mapping are some areas of similar soils that are moderately deep and some that contain more than 10 percent coarse fragments in the surface layer and subsoil. Also included are small areas of Reaville and Abbottstown soils.

Most of this soil is used for hay or pasture. Some large areas are used for corn and soybeans. This soil is generally wet and poorly suited to crops. It is suited to water-tolerant pasture grasses and trees.

The high water table and slow permeability limit most nonfarm uses of this soil. Capability unit IVw–2.

Duffield Series

The Duffield series consists of deep, well-drained, gently sloping to sloping soils on undulating landforms in the uplands. They formed in loamy material weathered chiefly from limestone.

In a representative profile in a cultivated area, the plow layer is dark-brown silt loam about 10 inches thick. The subsoil is 50 inches thick. The upper 4 inches is dark yellowish-brown silt loam; the next 31 inches is yellowish-brown silty clay loam; the lower 15 inches is yellowish-brown channery silt loam.

Runoff is medium, and the hazard of erosion is moderate to high. Available water capacity is high, and permeability is moderate. The slope, hazard of erosion, and hazard of ground-water contamination through underground solution channels are limitations to most nonfarm uses of these soils.

Representative profile of Duffield silt loam, 2 to 8 percent slopes, in a cultivated field 2 miles northeast of Buckingham:

Ap—0 to 10 inches, dark-brown (10YR 4/3) silt loam; moderate, very fine, granular structure; very friable; neutral; abrupt, smooth boundary.

B1—10 to 14 inches, dark yellowish-brown (10YR 4/4) silt loam; moderate, medium, platy structure; friable; neutral; clear, wavy boundary.

B21t—14 to 30 inches, yellowish-brown (10YR 5/4) silty clay loam; moderate, medium, subangular blocky structure; friable, sticky and plastic; thin clay films on peds; 2 percent coarse fragments; neutral; clear, wavy boundary.

B22t—30 to 45 inches, yellowish-brown (10YR 5/6) silty clay loam; moderate, coarse, subangular blocky structure; friable, sticky and plastic; thick clay films on peds and in wormholes and root channels; 10 percent coarse fragments; neutral; abrupt, wavy boundary.

B3—45 to 60 inches, yellowish-brown (10YR 5/8) channery silt loam; weak, medium, platy structure; slightly firm; 20 percent coarse fragments; slightly acid.

The solum ranges from 40 to 70 inches in thickness. Depth to bedrock ranges from 4 to 10 feet. The B horizon ranges from dark yellowish brown to yellowish brown. The Bt horizon is silt loam, silty clay loam, or clay loam. The upper part of the B horizon ranges from neutral to strongly acid, and the B3 and C horizons are medium acid or slightly acid.

Duffield soils are in close association with moderately well drained Clarksburg soils. They are in the same area as Lansdale, Lawrenceville, Chalfont, and Doylestown soils, which, except for the Lansdale soils, have a mottled B horizon and contain more silt than Duffield soils. Duffield soils are finer textured than Lansdale soils.

Duffield silt loam, 2 to 8 percent slopes (DsB).—This soil is in broad valleys in the uplands. Areas are irregular in shape and 3 to 40 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are a few small areas in swales that have a thick, dark surface layer. Also included are a few areas of Clarksburg soils.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area.

This soil has good drainage and gentle slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit IIe–2.

Duffield and Washington soils, 8 to 20 percent slopes (DtC).—This undifferentiated group is about 70 percent Duffield silt loam and 30 percent Washington gravelly silt loam. The proportion of soils varies in individual areas. Washington soils were mapped in Durham Creek Valley and Duffield soils in Lahaska and Aquetong Creek Valleys. These soils are on convex positions on the landscape. Areas are elongated and 3 to 25 acres in size. The profiles of these soils are similar to those described as representative of their respective series, but the surface layer and subsoil are slightly thinner in both soils.

Included with these soils in the areas of Washington soils are about 150 acres of soil that have fine sandy loam mantle that is 2 to 3 feet thick. This area lies just west of Riegelsville. Also included are some areas of eroded Duffield and Washington soils that are missing almost all of the original surface layer.

These soils are used for crops and pasture. They are suited to most cultivated crops commonly grown in the area.

The slope limits most nonfarm uses of these soils. Capability unit IIIe-1.

Duncannon Series

The Duncannon series consists of deep, well-drained, nearly level to gently sloping soils on uplands. These soils are on upper elevations in areas of low relief. They formed in silty, wind-deposited sediment that overlies shale, sandstone, and occasionally other material (fig. 21).

In a representative profile in a cultivated area, the plow layer is brown silt loam about 10 inches thick. The subsoil is 35 inches thick. The upper 7 inches is yellowish-brown silt loam; the lower 28 inches is dark-brown silt loam. The substratum is dark-brown and dark reddish-brown shaly silt loam that extends to a depth of 68 inches.

Runoff is medium, and the hazard of erosion is moderate to high. Available water capacity is high, and permeability is moderate. The hazard of erosion is a limitation to most nonfarm uses of these soils.

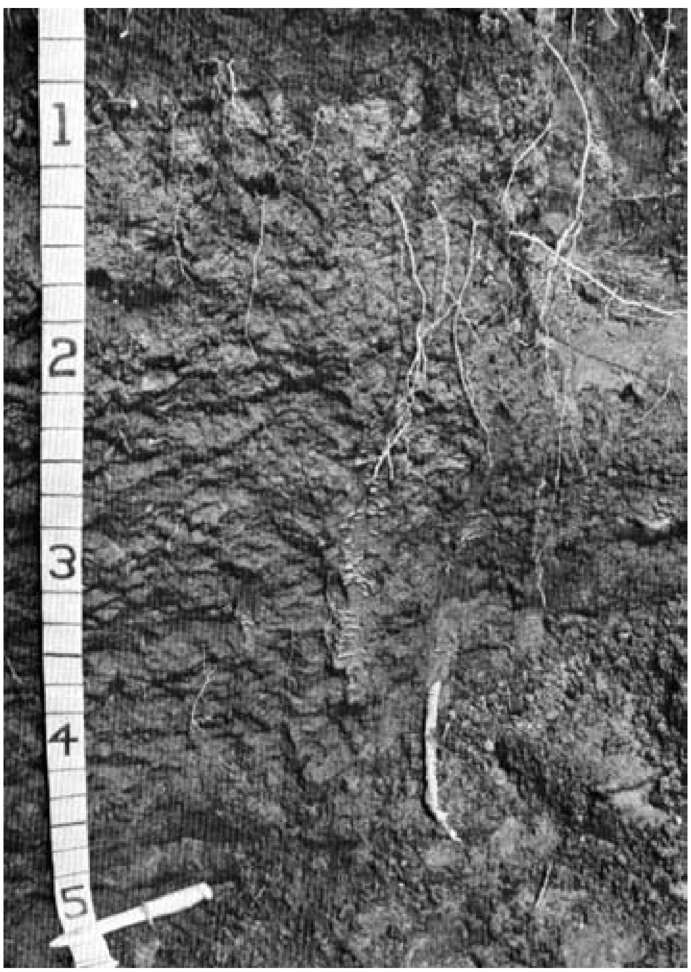

***Figure 21.*—Profile of Duncannon silt loam shows penetration of plant roots.**

Representative profile of a Duncannon silt loam, 0 to 3 percent slopes, in an idle field 3½ miles east of Newtown, near Mount Eyre Road, about 220 feet north of stone garage. This is the soil S68Pa-09-5(1-8) sampled for characterization analysis in tables 12 and 13:

Ap—0 to 10 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; friable, slightly sticky; 1 percent shale; strongly acid; abrupt, wavy boundary.

B1—10 to 17 inches, yellowish-brown (10YR 5/4) silt loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; material from Ap horizon fills wormholes; medium acid; clear, wavy boundary.

B21t—17 to 24 inches, dark-brown (7.5YR 4/4) silt loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; few thin clay films on faces of peds; 1 percent shale; medium acid; gradual, wavy boundary.

B22t—24 to 34 inches, dark-brown (7.5YR 4/4) silt loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; few thin clay films on faces of peds; 5 percent shale; medium acid; gradual, wavy boundary.

B3—34 to 45 inches, dark-brown (7.5YR 4/4) silt loam; weak, thick, platy structure; friable, slightly sticky and slightly plastic; few thin clay films in pores; medium acid; abrupt, wavy boundary.

IIC1—45 to 49 inches, dark-brown (7.5YR 4/4) shaly silt loam; common, medium, distinct, yellowish-red (5YR 5/8) and brown (10YR 5/3) mottles; weak, medium, platy structure; friable, slightly sticky and slightly plastic; few thin clay films in pores; 20 percent shale; medium acid; abrupt, wavy boundary.

IIC2—49 to 56 inches, dark-brown (7.5YR 4/2) shaly silt loam; weak, thin, platy structure; friable, slightly sticky and slightly plastic; few thin clay films in pores; 20 percent shale; medium acid; clear, wavy boundary.

IIIC3—56 to 68 inches, dark reddish-brown (5YR 3/3) shaly silt loam; thin yellowish-brown (10YR 5/8) bands; weak, thin, platy structure; friable, slightly sticky and slightly plastic; 20 percent shale; strongly acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock is more than 4 feet. The silt loam to very fine sandy loam mantle ranges from 40 to 70 inches in thickness, and the content of shale or gravel is as much as 10 percent. In some nonconforming horizons the content of shale or gravel ranges from 15 to 50 percent. The solum, where unlimed, is strongly acid or medium acid, and the C horizon ranges from slightly acid to strongly acid. The B horizon is brown, strong brown, yellowish brown, and dark brown. It is silt loam, loam, or very fine sandy loam. In some profiles a IIB horizon is at a depth below 40 inches and is silt loam, loam, or sandy loam. The C horizon, if present, and the IIC horizon are yellowish brown to dusky red. The C horizon is silt loam or very fine sandy loam. The IIC horizon is silt loam, loam, or sandy loam.

Duncannon soils are in close association with moderately well drained Lawrenceville soils, somewhat poorly drained Chalfont soils, and poorly drained Doylestown soils, all of which formed in similar material. Duncannon soils are in the same area as Lansdale soils and Readington soils but are finer textured than Lansdale soils and are not so red as Readington soils.

Duncannon silt loam, 0 to 3 percent slopes (DuA).—This soil is in areas of low relief on broad uplands. Areas are oval to elongated and 3 to 25 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some areas of similar soils that have a dark-brown or reddish-brown silt mantle less than 40 inches thick underlain by weathered red shale and sandstone material. Most of these areas are near Newtown.

Most of this soil is used for crops (fig. 22). It is suited to most cultivated crops commonly grown in the area.

This soil has good drainage and nearly level slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit I–2.

Duncannon silt loam, 3 to 8 percent slopes (DuB).—This soil is in areas of low relief on broad uplands. Areas are elongated or irregular in shape and 3 to 20 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the subsoil is slightly thinner and about 50 percent of the original surface layer is missing through erosion.

Included with this soil in mapping are some similar soils that have a dark-brown to reddish-brown silt mantle less than 40 inches thick underlain by weathered red shale and sandstone material. Most of these areas are near Newtown.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area.

This soil has good drainage and gentle slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit IIe–2.

Fallsington Series, Gravelly Subsoil Variant

The gravelly subsoil variant of the Fallsington series consists of deep, poorly drained, nearly level soils on terraces on the Coastal Plain. These soils are mainly in slight depressions and at the base of low slopes. They formed in loamy material of mixed old Coastal Plain sediment. The subsoil contains many coarse fragments.

In a representative profile in a wooded area, 2 inches of organic material covers the surface. The surface layer is grayish-brown silt loam about 7 inches thick. The subsoil is 43 inches thick. The upper 8 inches is light-gray and very pale brown gravelly silt loam and gravelly silty clay loam that has prominent, strong-brown, yellowish-red, and white mottles. The next 20 inches is gray gravelly sandy clay loam that has distinct, light-gray, reddish-yellow, brown, and white mottles. The lower 15 inches is strong-brown, mottled gravelly sandy clay loam.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is moderate, and permeability is moderate. The water table generally rises to or very

Figure 22.—**Typical landscape of Duncannon silt loam, 0 to 3 percent slopes, in alfalfa. Woodland in background is Lansdale loam.**

near the surface during wet seasons. Wetness is a limitation to most nonfarm uses of these soils.

Representative profile of Fallsington silt loam, gravelly subsoil variant, in a wooded area 1½ miles south of Yardley:

O2—2 inches to 0, black (5Y 2/1) partly decomposed leaf, twig, and other plant matter.

A2—0 to 7 inches, grayish-brown (10YR 5/2) silt loam; weak, very fine, granular structure; friable; very strongly acid; abrupt, wavy boundary.

B1g—7 to 10 inches, light-gray (5YR 7/1) gravelly silt loam; common, medium, prominent, strong-brown (7.5YR 5/8) and white (10YR 8/1) mottles; weak, medium, platy structure; friable, slightly sticky and slightly plastic; 30 percent gravel; very strongly acid; clear, wavy boundary.

B21t—10 to 15 inches, very pale brown (10YR 8/3) gravelly silty clay loam; many, medium, prominent, white (2.5Y 8/2) and yellowish-red (5YR 5/8) mottles; weak, medium and coarse, subangular blocky structure; firm, sticky and plastic; 30 percent gravel; clay films in pores; very strongly acid; clear, wavy boundary.

B22tg—15 to 23 inches, gray (5YR 6/1) gravelly sandy clay loam; common, fine, distinct, light-gray (10YR 7/1) and reddish-yellow (5YR 6/8) mottles; weak, medium, subangular blocky structure; firm, sticky and plastic; 45 percent gravel; clay films in pores; very strongly acid; gradual, wavy boundary.

B23g—23 to 35 inches, gray (5Y 6/1) gravelly sandy clay loam; common, fine, distinct, brown (7.5YR 5/4) and white (10YR 8/1) mottles; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; 55 percent gravel; very strongly acid; abrupt, wavy boundary.

B24—35 to 50 inches, strong-brown (7.5YR 5/6) gravelly sandy clay loam; light-gray (N 7/0) prism faces; very coarse, prismatic structure; firm, slightly sticky and plastic; 30 percent gravel; very strongly acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock is more than 5 feet. The B horizon ranges from light gray or gray and very pale brown to strong brown or yellowish brown. The B horizon ranges from silt loam or loam in the B1 horizon to silty clay loam, clay loam, or sandy clay loam in the B2 horizon. The B horizon is strongly acid or very strongly acid. The content of gravel in individual layers of the B2 horizon ranges from 30 to 60 percent.

Fallsington soils are in close association with well-drained Howell and moderately well drained Woodstown soils that formed in similar material. Fallsington soils also are associated with moderately well drained Lawrenceville and poorly drained Doylestown soils but are less silty and contain much more sand and gravel than those soils.

Fallsington silt loam, gravelly subsoil variant (0 to 3 percent slopes) (Fa).—Most of this soil is in slight depressions and at the base of low slopes. Areas are irregular in shape and 3 to 10 acres in size.

Included with this soil in mapping are some areas of similar soils that are very poorly drained. Also included are small areas of Doylestown soils and some small areas of Marsh.

Most of this soil is used for pasture or woodland, or it is idle. This soil generally is wet and poorly suited to crops. It is suited to water-tolerant pasture, grasses, and trees.

The high water table limits most nonfarm uses. Capability unit IIIw-2.

Hatboro Series

The Hatboro series consists of deep, poorly drained, nearly level soils on flood plains (fig. 23). These soils are mainly along small meandering streams. They formed in loamy alluvium that washed from upland soils underlain by gneiss, schist, and diabase.

In a representative profile in a pasture, the surface layer is dark-brown silt loam about 6 inches thick. The subsoil is 42 inches thick. The upper 26 inches is grayish-brown and dark grayish-brown silt loam that has yellowish-red, gray, and grayish-brown mottles. The lower 16 inches is light brownish-gray silt loam that has strong-brown and light brownish-gray mottles. The substratum is grayish-brown, mottled silt loam that extends to a depth of 60 inches.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is high, and permeability is moderate. Flooding generally occurs every year, late in winter and spring. Flooding and wetness are limitations to most nonfarm uses of these soils.

Representative profile of Hatboro silt loam, in a pasture 1 mile north of Eddington, east of Poquessing Creek:

Ap—0 to 6 inches, dark-brown (10YR 4/3) silt loam; weak, very thin, platy structure; very friable; medium acid; abrupt, smooth boundary.

B21g—6 to 13 inches, grayish-brown (10YR 5/2) silt loam; many, medium, distinct, grayish-brown (2.5Y 5/2) and yellowish-red (5YR 5/6) mottles; moderate, thin, platy structure; very friable; medium acid; abrupt, smooth boundary.

B22g—13 to 32 inches, dark grayish-brown (10YR 4/2) silt loam; many, coarse, faint, grayish-brown (10YR 5/2) and gray (10YR 5/1) mottles; weak, coarse, subangular blocky structure; very friable; very strongly acid; clear, wavy boundary.

B23g—32 to 48 inches, light brownish-gray (10YR 6/2) heavy silt loam; many, coarse, prominent, strong-brown (7.5YR 5/8) and light brownish-gray (2.5Y 6/2) mottles; weak, coarse, subangular blocky structure; very friable, slightly sticky and slightly plastic; many mica flakes; strongly acid; abrupt, smooth boundary.

IICg—48 to 60 inches, grayish-brown (10YR 5/2) silt loam; many, coarse, distinct, gray (N 5/0) and grayish-brown (2.5Y 5/2) mottles; massive; very friable, slightly plastic; very strongly acid.

The solum ranges from 40 to 60 inches in thickness. Depth to stratified sand and gravel is more than 40 inches. Depth to bedrock ranges from 5 to 10 feet. The content of coarse fragments throughout the solum ranges from 0 to 5 percent. The B horizon ranges from dark grayish brown to light brownish gray. It is silt loam, silty clay loam, and loam. The B and C horizons are naturally medium acid to very strongly acid.

Hatboro soils are in association with moderately well drained to somewhat poorly drained Rowland soils that are also on the flood plain.

Hatboro silt loam (0 to 3 percent slopes) (Ha).—This soil is on smooth or slightly concave flood plains. Areas are elongated and narrow and 3 to 50 acres or more in size.

Included with this soil in mapping are some flood plain soils that formed in similar material but are moderately well drained and well drained. Also included are a few small areas of alluvial soils that have a stony surface layer.

Most of this soil is used for pasture or is idle. Most areas are too narrow to be farmed.

The hazard of flooding and high water table limit most nonfarm uses of this soil. Capability unit IVw-1.

Figure 23.—**Typical landscape of Hatboro silt loam in pasture.**

Howell Series

The Howell series consists of deep, well-drained, nearly level to gently sloping soils on terraces on the Coastal Plain. These soils are on upper convex slopes. They formed in loamy and clayey material of mixed old Coastal Plain sediment.

In a representative profile in a cultivated area, the surface layer is dark-brown and dark grayish-brown silt loam about 9 inches thick. The subsoil is 33 inches thick. The upper 19 inches is strong-brown silty clay loam and clay loam. The lower 14 inches is strong-brown gravelly clay loam. The substratum is strong-brown sandy clay loam and gravelly clay loam that extends to a depth of 50 inches.

Runoff is medium, and the hazard of erosion is slight to moderate. Available water capacity is high, and permeability is moderately slow. Restricted permeability is a limitation to most nonfarm uses of these soils.

Representative profile of Howell silt loam, 3 to 8 percent slopes, in an idle field 75 feet north of U.S. Highway 1, in Middletown Township:

Ap—0 to 7 inches, dark-brown (10YR 3/3) silt loam; moderate, fine and very fine, granular structure; friable; 10 percent gravel; strongly acid; abrupt, smooth boundary.

A3—7 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, thin, platy structure; friable; 10 percent gravel; strongly acid; abrupt boundary.

B1—9 to 16 inches, strong-brown (7.5YR 5/8) silty clay loam; moderate, medium, subangular blocky structure parting to moderate, fine, subangular blocky; firm, sticky and plastic; 10 percent gravel; few thin clay films on faces of peds; A horizon material fills root channels; strongly acid; clear, wavy boundary.

B21t—16 to 28 inches, strong-brown (7.5YR 5/8) heavy clay loam; moderate, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; 10 percent gravel; thick clay films on faces of peds; medium acid; clear, wavy boundary.

B22t—28 to 42 inches, strong-brown (7.5YR 5/6) gravelly clay loam; weak, thick, platy structure; firm, sticky and plastic; thick clay films on faces of peds; 15 percent gravel; strongly acid; abrupt, wavy boundary.

IIC1—42 to 46 inches, strong-brown (7.5YR 5/8) sandy clay loam; massive; firm, slightly sticky; 10 percent gravel; very strongly acid; abrupt, wavy boundary.

IIC2—46 to 50 inches, strong-brown (7.5YR 5/8) gravelly clay loam; massive; firm, sticky and plastic; 20 percent gravel; few clay films on gravel; very strongly acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock is more than 10 feet. The content of coarse fragments ranges from 5 to 20 percent in the solum and from 10 to 40 percent in the IIC horizon. The Bt horizon ranges from strong brown to yellowish-red. It is silty clay loam,

clay loam, and light clay. The C horizon is strong brown and yellowish brown, and it is sandy clay loam to clay.

Howell soils are in close association with moderately well drained Woodstown soils and Fallsington soils, all of which formed in similar material. Howell soils are near moderately well drained Lawrenceville and poorly drained Doylestown soils, but they are less silty than those soils.

Howell silt loam, 0 to 3 percent slopes (HoA).—This soil is on broad, uniform sides of terraces on the Coastal Plain. Areas are irregular in shape and 3 to 20 acres in size. The profile of this soil is similar to the one described as representative of the series, except that the surface layer and subsoil are slightly thicker.

Included with this soil in mapping are some areas of similar soils that contain less clay in the subsoil and some areas of soils that have a thin mantle of silt on the surface.

Most of this soil is used for crops. Some areas are idle and are designated for urban development. This soil is suited to most cultivated crops commonly grown in the area.

Moderately slow permeability limits some nonfarm uses of this soil. Capability unit I–3.

Howell silt loam, 3 to 8 percent slopes (HoB).—This soil is on sides of terraces on the Coastal Plain. Areas are irregular in shape and 3 to 10 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some areas of similar soils that contain less clay in the subsoil and some areas of soils that have a thin mantle of silt on the surface .

Most of this soil is used for crops. Some areas are idle and are designated for urban development. This soil is suited to most cultivated crops commonly grown in the area.

Moderately slow permeability limits some nonfarm uses of this soil. Capability unit IIe–3.

Klinesville Series

The Klinesville series consists of shallow, well-drained, gently sloping to very steep soils on uplands. These soils are on side slopes, on hills, and on ridges. They formed in loamy material weathered chiefly from red shale and fine-grained sandstone. They contain many coarse fragments.

In a representative profile in a cultivated area, the plow layer is dark reddish-brown very shaly silt loam about 7 inches thick. The subsoil is 5 inches thick, is dark reddish-brown very shaly silt loam, and has weak blocky structure. The substratum is dark reddish-brown very shaly silt loam 6 inches thick. Reddish-brown, fractured shale bedrock is at a depth of 18 inches.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Available water capacity is very low, and permeability is moderately rapid. The depth to bedrock and slope are limitations to most nonfarm uses of these soils.

Representative profile of Klinesville very shaly silt loam, 3 to 8 percent slopes, in an orchard 1½ miles southeast of Ottsville:

Ap—0 to 7 inches, dark reddish-brown (5YR 3/3) very shaly silt loam; moderate, fine, granular structure; friable; 50 percent shale fragments; medium acid; abrupt, smooth boundary.

B2—7 to 12 inches, dark reddish-brown (2.5YR 3/4) very shaly silt loam; weak, fine, subangular blocky structure; friable; 65 percent shale fragments; medium acid; gradual, wavy boundary.

C—12 to 18 inches, dark reddish-brown (2.5YR 3/4) very shaly silt loam; massive; friable; 80 percent shale fragments; strongly acid; gradual, wavy boundary.

R—18 inches +, reddish-brown (2.5YR 4/4), fractured shale bedrock.

The thickness of the solum and depth to bedrock range from 10 to 20 inches. The content of coarse fragments of shale and some sandstone ranges from 35 to 70 percent in the Ap horizons, from 45 to 75 percent in the B horizon, and from 70 to 90 percent in the C horizon. The B and C horizons range from dark reddish brown to weak red and are medium to very strongly acid.

Klinesville soils are in close association with Penn and Reaville soils that formed in similar material but are deeper to bedrock. Klinesville soils are better drained than Reaville soils. They are in the same area as Readington, Abbottstown, and Doylestown soils but those are deep soils that have a fragipan.

Klinesville very shaly silt loam, 3 to 8 percent slopes (KlB).—This soil is on hilltops and ridgetops. Areas are oval or elongated and 3 to 50 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some areas of soils that have fractured shale bedrock at a depth of less than 10 inches. Also included are some small areas of Penn and Reaville soils.

Most of this soil is used for crops. The soil is droughty, and the choice of crops that can be successfully grown is limited.

The depth to bedrock limits most nonfarm uses of this soil. Capability unit IIIe–4.

Klinesville very shaly silt loam, 8 to 15 percent slopes (KlC).—This soil is on convex sides of hills and ridges. Areas are irregular in shape and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but it is slightly shallower over bedrock.

Included with this soil in mapping are some areas of soils that have fractured shale bedrock at a depth of less than 10 inches. Also included are small areas of Penn and Reaville soils.

Most of this soil is used for hay or pasture. The soil is droughty, but it is suited to hay, pasture, and the more drought-resistant crops.

The depth to bedrock limits most nonfarm uses of this soil. Capability unit IVe–3.

Klinesville very shaly silt loam, 15 to 25 percent slopes (KlD).—This soil is on convex sides of hills and ridges (fig. 24). Areas are elongated and 3 to 25 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but it is slightly shallower over bedrock and the content of shale fragments is higher.

Included with this soil in mapping are some areas of very shallow soils, eroded Klinesville soils, and extremely shaly Klinesville soils. Also included are a few small areas of rock outcrop.

Most of this soil is used for woodland or pasture. The depth to bedrock, droughtiness, and slope limit use for cultivated crops.

Figure 24.—Wooded area of Klinesville very shaly silt loam, 15 to 25 percent slopes. Red shale bedrock is exposed in foreground.

The depth to bedrock and slope limit most nonfarm uses of this soil. Capability unit VIe-1.

Lansdale Series

The Lansdale series consists of deep, well-drained, nearly level to very steep soils on uplands. These soils are on side slopes and ridges. They formed in loamy material weathered chiefly from brown and yellowish-brown shale and sandstone.

In a representative profile in a cultivated area, the plow layer is dark-brown loam about 7 inches thick. The subsoil is 22 inches thick. The upper 5 inches is strong-brown loam; the next 11 inches is brown loam; and the lower 6 inches is brown fine sandy loam. The substratum is brown and yellowish-brown channery fine sandy loam and channery loamy sand that extends to a depth of 60 inches.

Runoff is medium to rapid, and the hazard of erosion is slight to high. Available water capacity is moderate, and permeability is moderately rapid. The slope and stoniness are limitations to most nonfarm uses of these soils.

Representative profile of Lansdale loam, 3 to 8 percent slopes, in a cultivated field one-half mile southeast of Peters Corner:

Ap—0 to 7 inches, dark-brown (10YR 3/3) loam; weak, fine, granular structure; very friable; 2 percent sandstone fragments; medium acid; abrupt, smooth boundary.

B1—7 to 12 inches, strong-brown (7.5YR 5/6) loam; moderate, medium, subangular blocky structure; friable; 2 percent sandstone fragments; strongly acid; clear, wavy boundary.

B2t—12 to 23 inches, brown (7.5YR 4/4) loam; moderate, coarse, subangular blocky structure; firm, slightly sticky; thin, discontinuous clay films on peds; 7 percent sandstone fragments; strongly acid; clear, wavy boundary.

B3—23 to 29 inches, brown (7.5YR 4/4) fine sandy loam; weak, coarse, subangular blocky structure; friable; 12 percent sandstone fragments; very strongly acid; clear, wavy boundary.

C1—29 to 36 inches, brown (7.5YR 4/4) channery fine sandy loam; massive; firm; 30 percent sandstone fragments; very strongly acid; abrupt, wavy boundary.

C2—36 to 60 inches, yellowish-brown (10YR 5/6) channery loamy sand; single grained; very friable; 35 percent sandstone fragments; very strongly acid.

The solum ranges from 20 to 40 inches in thickness. Depth to bedrock ranges from 4 to 7 feet. The content of coarse fragments ranges from 2 to 10 percent in the A horizon, from 2 to 25 percent in the B horizon, and from 15 to 45 percent in the C horizon. The B horizon ranges from brown to yellowish brown or strong brown. It is loam to heavy sandy loam. The C horizon ranges from fine sandy loam to loamy sand.

Lansdale soils are in close association with moderately deep Penn and Steinsburg soils that formed in material weathered chiefly from red shale and brown sandstone respectively. Also associated with Lansdale soils are moderately well drained Readington soils, somewhat poorly drained Abbottstown soils, and poorly drained Doylestown soils that are all deep and have a fragipan.

Lansdale loam, 0 to 3 percent slopes (LaA).—This soil is on broad ridgetops. Areas are oval or elongated and 3 to 10 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the subsoil is slightly thicker.

Included with this soil in mapping are some areas of similar soils that have a subsoil that extends to a depth of more than 40 inches. Also included are some areas of Steinsburg soils that contain less than 15 percent gravel in the surface layer.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area.

This soil has good drainage and nearly level slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit I–3.

Lansdale loam, 3 to 8 percent slopes (LaB).—This soil is on convex sides of hills and ridges (fig. 25). Areas are elongated and 5 to 100 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some areas of similar soils that have a subsoil that extends to a depth of more than 40 inches. Also included are some areas of Steinsburg soils that contain less than 15 percent gravel in the surface layer.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area.

This soil has good drainage and gentle slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit IIe–3.

Lansdale loam, 8 to 15 percent slopes (LaC).—This soil is adjacent to creeks and flood plains on rolling uplands. Slopes are short. Areas are elongated or irregular in shape and about 3 to 25 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the subsoil is slightly thinner and the content of coarse fragments is greater.

Included with this soil in mapping are areas of Steinsburg soils that contain less than 15 percent gravel in the surface layer. Also included are some areas of eroded Lansdale soils that are missing almost all of the original surface layer.

Figure 25.—Typical landscape of Lansdale loam, 3 to 8 percent slopes, farmed intensively to corn.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area.

The slope limits most nonfarm uses of this soil. Capability unit IIIe-2.

Lansdale loam, 15 to 25 percent slopes (LaD).—This soil is on convex sides of ridges and adjacent to creeks and flood plains. Areas are elongated and 3 to 10 acres or more in size. Slopes are short in areas adjacent to creeks and flood plains. The profile of this soil is similar to the one described as representative of the series, but the subsoil is thinner and the content of coarse fragments is greater.

Included with this soil in mapping are some areas of eroded Lansdale soils that are missing almost all of the original surface layer. Also included are areas of Steinsburg soils.

Most of this soil is used for hay or pasture. It generally is too steep for cultivation except where intensive conservation practices are followed. It is suited to pasture or hay.

The slope limits most nonfarm uses of this soil. Capability unit IVe-1.

Lansdale extremely stony loam, 0 to 8 percent slopes (LdB).—This soil is on convex, undulating to smooth ridgetops. Areas are oval or elongated and 5 to 100 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thin and natural instead of plowed. About 5 to 25 percent of the surface is covered by stones that are mainly sandstone and some conglomerate.

Included with this soil in mapping are small areas of Readington soils that have a similar stony surface layer.

Most of this soil is wooded. It is too stony to be cultivated and is suited to woodland and wildlife habitat.

The extremely stony surface limits some nonfarm uses of this soil. Capability unit VIIs-1.

Lansdale extremely stony loam, 8 to 25 percent slopes (LdD).—This soil is on convex sides of ridges and adjacent to creeks and flood plains. Areas are elongated and 5 to 100 acres or more in size. Slopes are short in areas adjacent to creeks and flood plains. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thin and natural instead of plowed and the subsoil is thinner and contains more coarse fragments. About 5 to 25 percent of the surface is covered by stones that are mainly sandstone and some conglomerate.

Included with this soil in mapping are some small areas of Steinsburg soils that have a similar stony surface layer. Also included are some areas of deep, more silty soils that have a stony or flaggy surface layer.

Most of this soil is wooded. It is too stony to be cultivated and is suited to woodland and wildlife habitat.

The slope and stoniness limit most nonfarm uses of this soil. Capability unit VIIs-1.

Lansdale extremely stony loam, 25 to 50 percent slopes (LdE).—This soil is on sides of ridges and adjacent to creeks and flood plains. Areas are elongated and 5 to 100 acres or more in size. Slopes are short in areas adjacent to creeks and flood plains. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thin and natural instead of plowed and the subsoil is thinner and contains more coarse fragments. About 5 to 25 percent of the surface is covered by stones that are mainly sandstone and some conglomerate.

Included with this soil in mapping are some small areas of Steinsburg gravelly loam soils and some Steinsburg soils that have a similar cover of stones on the surface. Also included are some areas of deep, more silty soils that have a stony or flaggy surface layer.

Most of this soil is wooded. It is too steep and stony to be cultivated and is suited to woodland and wildlife habitat.

The slope and stoniness limit most nonfarm uses of this soil. Capability unit VIIs-3.

Lawrenceville Series

The Lawrenceville series consists of deep, moderately well drained, nearly level to gently sloping soils on uplands. These soils are on middle and lower elevations in areas of low relief. They formed in silty, windblown deposits underlain by a variety of material weathered chiefly from shale and sandstone.

In a representative profile in a cultivated area, the plow layer is dark-brown silt loam about 11 inches thick. The subsoil is 36 inches thick. The upper 14 inches is yellowish-brown silt loam. The lower 22 inches is compact, very firm, yellowish-brown and strong-brown silt loam that has gray and brown mottles. The substratum extends to a depth of 81 inches. The upper 25 inches is brown silt loam that has light brownish-gray and strong-brown mottles in the upper part. The lower 9 inches is brown sandy loam.

Runoff is medium, and the hazard of erosion is slight to high. Available water capacity is high, and permeability is moderately slow. The water table generally rises to within 18 to 36 inches of the surface during wet seasons. Restricted permeability and wetness are limitations to most nonfarm uses of these soils.

Representative profile of Lawrenceville silt loam, 0 to 3 percent slopes, in a cultivated field 1½ miles southeast of Newton. This is the soil S68Pa-09-3(1-9) sampled for characterization analysis in tables 12 and 13:

Ap—0 to 11 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

B21t—11 to 19 inches, yellowish-brown (10YR 5/4) silt loam; weak, fine, subangular blocky structure; friable; neutral; clear, wavy boundary.

B22t—19 to 25 inches, yellowish-brown (10YR 5/6) silt loam; few, fine, faint, strong-brown (7.5YR 5/6) and yellowish-brown (10YR 5/4) mottles; weak, fine, subangular blocky structure; friable; neutral; clear, wavy boundary.

Bx1—25 to 34 inches, yellowish-brown (10YR 5/6) silt loam; yellowish-brown (10YR 5/4) prism faces; many, medium, prominent, strong-brown (7.5YR 5/6) and light-gray (10YR 7/1) mottles; weak, very coarse, prismatic structure parting to weak, coarse, subangular blocky; firm; silt and clay films on prisms; very strongly acid; clear, wavy boundary.

Bx2—34 to 40 inches, strong-brown (7.5YR 5/6) silt loam; yellowish-brown (10YR 5/4) prism faces; many, medium, distinct, light brownish-gray (10YR 6/2) mottles; weak, very coarse, prismatic structure parting to weak, coarse, subangular blocky; firm to very firm; thin silt and clay films in pores; very strongly acid; clear, wavy boundary.

Bx3—40 to 47 inches, yellowish-brown (10YR 5/4) silt loam; light brownish-gray (10YR 6/2) prism faces; many, coarse, prominent, strong-brown (7.5YR 5/6) and light-gray (10YR 7/1) mottles; weak, very coarse, prismatic structure parting to weak blocky; very firm; very strongly acid; clear, wavy boundary.

C1—47 to 57 inches, brown (7.5YR 5/4) silt loam; many, medium, distinct strong-brown (7.5YR 5/6) and light brownish-gray (10YR 6/2) mottles; weak, medium, platy structure; firm; strongly acid; clear, wavy boundary.

C2—57 to 72 inches, brown (10YR 5/3) silt loam; weak, medium, platy structure; slightly firm; strongly acid; abrupt, wavy boundary.

IIC3—72 to 81 inches, brown (7.5YR 5/4) sandy loam; massive; slightly firm; 10 percent coarse fragments; strongly acid.

The solum ranges from 40 to 75 inches in thickness. Depth to bedrock ranges from 4 to 8 feet. Depth to the fragipan ranges from 24 to 32 inches. Depth of the silty mantle over nonconforming material ranges from 36 to 80 inches. Low-chroma mottling begins at a depth of 20 to 30 inches. The Bt horizon ranges from yellowish brown to strong brown. The silty Bx horizon ranges from brown to yellowish brown. The underlying nonconforming material has a hue of 2.5YR to 2.5Y. The content of coarse fragments in the nonconforming material ranges from 10 to 85 percent.

The moderately well drained Lawrenceville soils are in close association with and are in a drainage sequence with well drained Duncannon soils, somewhat poorly drained Chalfont soils, and poorly drained Doylestown soils. Lawrenceville soils also are associated with Readington soils that have more reddish hues and contain more coarse fragments.

Lawrenceville silt loam, 0 to 3 percent slopes (LgA).—This soil is in smooth to concave areas of low relief in the silt-mantled uplands (fig. 26). Areas are irregular in shape and 3 to 50 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some areas of Duncannon, Readington, and Chalfont soils. Also included are some areas of similar soils that have a silt mantle less than 40 inches thick.

***Figure 26.*—Typical landscape of Lawrenceville silt loam, 0 to 3 percent slopes, that was formerly cropped but is now converted to a golf course.**

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area. Alfalfa and winter grain are subject to damage from frost heaving.

The seasonal high water table and moderately slow permeability limit most nonfarm uses of this soil. Capability unit IIw–2.

Lawrenceville silt loam, 3 to 8 percent slopes (LgB).—This soil is on smooth to concave areas of low relief in the silt-mantled uplands (fig. 27). Areas are elongated or irregular in shape and 3 to 50 acres or more in size.

Included with this soil in mapping are some areas of Duncannon, Readington, and Chalfont soils. Also included are some areas of similar soils that have a silt mantle less than 40 inches thick.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area. Alfalfa and winter grain are subject to damage from frost heaving.

The seasonal high water table and moderately slow permeability limit most nonfarm uses of this soil. Capability unit IIe–5.

Lehigh Series

The Lehigh series consists of deep, moderately well drained to somewhat poorly drained, gently sloping to moderately steep soils on uplands. These soils are on ridges and side slopes. They formed in loamy material weathered chiefly from gray metamorphosed shale and sandstone.

In a representative profile in an idle field, the plow layer is very dark gray channery silt about 6 inches thick. The subsoil is 34 inches thick. The upper 10 inches is very dark grayish-brown and very dark gray silt loam and silty clay loam. The next 11 inches is dark-gray channery silty clay loam that has faint, light-gray and brown mottles. The lower 13 inches is dark-gray very channery silty clay loam that has prominent, light olive-gray and pinkish-gray mottles. The substratum is gray, mottled very channery silty clay loam 10 inches thick. Dark-gray, fractured argillite shale bedrock is at a depth of 50 inches.

Runoff is medium, and the hazard of erosion is moderate to high. Available water capacity is moderate, and permeability is slow. The water table generally rises to within 12 to 24 inches of the surface during wet seasons. Restricted permeability, wetness, slope, and stoniness are limitations to most nonfarm uses of these soils.

Representative profile of Lehigh channery silt loam, 2 to 8 percent slopes, in an idle field off Route 563, in Haycock Township:

Ap—0 to 6, inches, very dark gray (10YR 3/1) channery heavy silt loam; weak, fine, granular structure; friable, slightly sticky and slightly plastic; 15 percent coarse fragments; neutral; abrupt, smooth boundary.

B1—6 to 9 inches, very dark grayish-brown (10YR 3/2) heavy silt loam; weak, medium, subangular blocky structure; friable, sticky and slightly plastic; 5 percent coarse fragments; neutral; clear, wavy boundary.

B21t—9 to 16 inches, very dark gray (10YR 3/1) silty clay loam; moderate, medium, subangular blocky structure; friable, sticky and plastic; thin, nearly continuous clay films on peds; 5 percent coarse fragments; neutral; clear, wavy boundary.

Figure 27.—Typical landscape of Lawrenceville and Chalfont soils. Lawrenceville silt loam, 3 to 8 percent slopes, is in winter grain in the foreground; Chalfont silt loam, 0 to 3 percent slopes, is in corn stubble in the center.

B22t—16 to 27 inches, dark-gray (10YR 4/1) channery silty clay loam; few, fine, faint, light-gray (10YR 6/1) and brown (7.5YR 5/2) mottles; moderate medium, subangular blocky structure; slightly firm, sticky and plastic; 30 percent coarse fragments; thick, nearly continuous clay films on peds; neutral; abrupt, wavy boundary.

B23tg—27 to 40 inches, dark-gray (10YR 4/1) very channery silty clay loam; many, coarse, prominent, light olive-gray (5Y 6/2) and pinkish-gray (5YR 7/2) mottles; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; firm, sticky and plastic; thick, nearly continuous clay films on peds; 60 percent coarse fragments; medium acid; gradual, wavy boundary.

Cg—40 to 50 inches, gray (10YR 5/1) very channery silty clay loam; many, coarse, prominent, light-gray (5Y 7/1) and gray (5YR 5/1) mottles; massive; firm, sticky and plastic; few thin clay films on channery fragments; 90 percent coarse fragments; medium acid; gradual, wavy boundary.

R—50 inches +, dark-gray (10YR 4/1), fractured argillite shale bedrock.

The solum ranges from 20 to 40 inches in thickness. Depth to bedrock ranges from 40 to 60 inches. Low-chroma mottling begins at a depth of 15 to 20 inches. The B horizon ranges from very dark gray to brown. It is heavy silt loam or silty clay loam. The content of coarse fragments in individual layers in the B horizon ranges from 5 to 30 percent in the upper part and from 25 to 60 percent in the lower part. The C horizon is strongly acid to medium acid. The content of coarse fragments in the C horizon ranges from 50 to 90 percent.

529-461 O—75——7

The moderately well drained to somewhat poorly drained Lehigh soils are in close association with deep, poorly drained Doylestown and Towhee soils.

Lehigh channery silt loam, 2 to 8 percent slopes (LhB).—This soil is on tops and sides of ridges. Areas generally are elongated and 3 to 50 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some areas of similar soils that have a fragipan, a limited acreage of similar soils that are well drained, and some small areas of eroded Lehigh soils. Also included are some areas of very stony Lehigh soils that are indicated on the detailed soil map by a special symbol.

Most of this soil is used for crops or is idle. It is suited to moisture-tolerant field crops, grasses, and legumes. Alfalfa and winter grain are subject to damage from frost heaving.

The seasonal high water table and slow permeability limit most nonfarm uses of this soil. Capability unit IIIw-1.

Lehigh channery silt loam, 8 to 18 percent slopes (LhC).—This soil is on sides of ridges. Areas are elongated and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsoil are slightly thinner.

Included with this soil in mapping are some areas of similar soils that have a fragipan, a limited acreage of similar soils that are well drained, and some areas of eroded Lehigh soils.

Most of this soil is used for crops and pasture. It is suited to moisture-tolerant field crops, grasses, and legumes. Alfalfa and winter grain are subject to damage from frost heaving.

The seasonal high water table, slow permeability, and slope limit most nonfarm uses of this soil. Capability unit IIIe-6.

Lehigh extremely stony silt loam, 8 to 25 percent slopes (LlD).—This soil is on middle and lower elevations on ridges and hills. Areas are irregular in shape and 5 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, except that the surface layer is thin and natural instead of plowed. About 5 to 25 percent of the surface is covered with stones.

Included with this soil in mapping are some areas of similar stony soils that have a fragipan and some areas of extremely stony soils that formed in similar material and are well drained.

Almost all of this soil is wooded. It is too stony to be cultivated and is suited to woodland or wildlife habitat.

The extremely stony surface, the seasonal high water table, slow permeability, and slope limit most nonfarm uses of this soil. Capability unit VIIs-2.

Manor Series

The Manor series consists of deep, well-drained, gently sloping to very steep soils on uplands. These soils are mainly on side slopes and ridgetops. They formed in loamy material weathered from schist and gneiss.

In a representative profile in a cultivated area, the plow layer is dark-brown loam about 7 inches thick. The subsoil is yellowish-red loam and channery loam 12 inches thick. The substratum is yellowish-red channery sandy loam that extends to a depth of 60 inches. It is highly micaceous saprolite derived from disintegrated soft bedrock.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Available water capacity is moderate, and permeability is moderately rapid. The slope and stoniness are limitations to most nonfarm uses of these soils.

Representative profile of Manor loam, 3 to 8 percent slopes, in an idle field 300 feet south of Port Royal, in Philadelphia County:

Ap—0 to 7 inches, dark-brown (7.5YR 4/4) loam; moderate, fine, granular structure; friable; 10 percent coarse fragments; many mica flakes; strongly acid; abrupt, smooth boundary.

B1—7 to 10 inches, yellowish-red (5YR 5/6) loam; weak, fine, subangular blocky structure; friable; 12 percent coarse fragments; strongly acid; clear, wavy boundary.

B2—10 to 19 inches, yellowish-red (5YR 5/6) channery loam; moderate, medium, subangular blocky structure; friable; 20 percent coarse fragments; medium acid; gradual, irregular boundary.

C1—19 to 32 inches, yellowish-red (5YR 4/6) micaceous channery sandy loam; massive; friable; 25 percent coarse fragments; slightly acid; gradual, irregular boundary.

C2—32 to 60 inches, variegated colors of yellowish-red (5YR 4/6), red (2.5YR 4/8), and brown (10YR 5/3) micaceous channery sandy loam saprolite; massive; friable; 25 percent coarse fragments; slightly acid.

The solum ranges from 15 to 24 inches in thickness. Depth to bedrock ranges from 4 to 12 feet. The content of coarse fragments ranges from less than 5 percent to 10 percent in the surface layer and from 5 to 30 percent in the B and C horizons. The B2 horizon is strong brown or yellowish red. It is loam or light loam. The C horizon is highly micaceous saprolite than ranges from 2½ to 10 feet in thickness. It is loam or sandy loam.

Manor soils in Bucks and Philadelphia Counties have a slightly higher reaction than the defined range for the series, but this difference does not alter the use, management or behavior of these soils.

Manor soils are in close association with Chester and Urbana soils, but they have a thinner solum and a coarser textured subsoil than these soils. They also are better drained than Urbana soils.

Manor loam, 3 to 8 percent slopes (MaB).—This soil is on hilltops and ridgetops. Areas mapped are oval or elongated and 3 to 10 acres or more in size. The profile of this soil is the one described as reperesntative of the series.

Included with this soil in mapping are some areas of similar soils that are moderately deep to bedrock and some areas of soils that are coarser textured in the lower part of the profile. Also included are some areas of soils that have a thin subsoil containing accumulated clay.

Most of this soil is used for park developments or crops; some areas are idle and designated for urban development. It is suited to most cultivated crops commonly grown in the area.

This soil has good drainage and gentle slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit IIe-4.

Manor loam, 8 to 15 percent slopes (MaC).—This soil is on sides of ridges and hills. Areas are elongated and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the subsoil is slightly thinner.

Included with this soil in mapping are some areas of soils that are moderately deep to bedrock and some areas of soils that are coarser textured in the lower part of the profile.

Almost all of this soil is used for park developments or crops. It is suited to most cultivated crops commonly grown in the area.

Slope limits most nonfarm uses of this soil. Capability unit IIIe-3.

Manor loam, 15 to 25 percent slopes (MaD).—This soil is on sides of ridges and hills and adjacent to drainageways. Areas generally are elongated and 3 to 50 acres in size. Slopes are short in areas adjacent to drainageways. The profile of this soil is similar to the one described as representative of the series, but a few more coarse fragments are present.

Included with this soil in mapping are some areas of eroded Manor soils that are missing all of the original surface layer. Also included are some soils that are coarser textured in the lower part of the profile.

Almost all of this soil is used for park developments or for hay or pasture. It is suited to limited, long-term hay crops.

Slope limits most nonfarm uses of this soil. Capability unit IVe–2.

Manor extremely stony loam, 8 to 25 percent slopes (MbD).—This soil is on sides of hills and ridges and on short slopes adjacent to narrow flood plains. Areas are elongated and 5 to 75 acres or more in size. The profile of this soil is similar to the one described as representative of the series, except that the surface layer is thin and natural instead of plowed. About 5 to 25 percent of the surface is covered with stones.

Included with this soil in mapping are some areas of similar soils that are moderately deep to bedrock and some areas of soils that have a thin subsoil containing accumulated clay.

Most of this soil is used as woodland and estates. It is too stony to be cultivated.

Slope and stoniness limit most nonfarm uses of this soil. Capability unit VIIs–1.

Manor and Chester extremely stony loams, 25 to 50 percent slopes (McE).—This undifferentiated group is about 55 percent Manor extremely stony loam and 45 percent Chester extremely stony loam. The proportion of soils varies in individual areas. These soils are mainly on ridges and short side slopes adjacent to creek flood plains. Areas are elongated and are 5 to 100 acres or more in size. The profiles of these soils are similar to those described as representative of their respective series, but the surface layer is thin and natural instead of plowed in both these soils. Also, the content of coarse fragments in the solum is more and the solum is slightly thinner. About 10 to 25 percent of the surface is covered with stones.

Included with these soils in mapping in Durham Township are 145 acres of rocky soils that formed in material weathered from limestone. Also included are some similar soils that are moderately deep and some steep Manor soils that do not have a cover of stones on the surface.

Most of these soils are used as woodland. They have an extremely stony surface and steep slopes and are not suitable for cultivation.

The slope and stoniness limit most nonfarm uses of these soils. Capability unit VIIs–3.

Marsh

Marsh (Mh) is along shorelines subject to ponding or tidal overflow or is in depressions where runoff collects. The soil material is variable, but it consists mostly of loamy to clayey marine and alluvial deposits. It is always very wet. Areas are irregular in shape and range from 5 to 100 acres or more in size. Included in mapping are a few small areas of very poorly drained soils that are not so frequently flooded.

Reeds, cattails, and other grasslike wetland plants grow on Marsh. It is much too wet for cultivation but is suited to wildlife or esthetic uses.

Most nonfarm uses are limited by flooding and wetness. Capability unit VIIIw–1.

Mount Lucas Series

The Mount Lucas series consists of deep, moderately well drained and somewhat poorly drained, nearly level to moderately steep soils on uplands. These soils are on smooth to concave lower elevations. They formed in loamy material weathered chiefly from diabase.

In a representative profile in a wooded area, 3 inches of debris and organic material covers the surface. The surface layer is dark grayish-brown and brown silt loam about 8 inches thick. The subsoil is 38 inches thick. The upper 12 inches is brown and reddish-yellow silt loam and silty clay loam; the lower 26 inches is brown channery heavy silt loam that has prominent white and reddish-yellow mottles. The substratum is reddish-yellow channery silt loam that extends to a depth of 60 inches.

Runoff is medium, and the hazard of erosion is moderate to high. Available water capacity is high, and permeability is slow. The water table generally rises to within 12 to 24 inches of the surface during wet seasons. Restricted permeability, wetness, slope, and stoniness are limitations to most nonfarm uses of these soils.

Representative profile of Mount Lucas silt loam in a wooded area of Mount Lucas extremely stony silt loam, 0 to 8 percent slopes, 80 feet north of road T463, in Haycock Township:

O1—3 inches to 1 inch, mixture of leaves, twigs, and small branches.

O2—1 inch to 0, partly decomposed organic matter and some black (10YR 2/1) loam.

A1—0 to 3 inches, dark grayish-brown (10YR 4/2) silt loam; weak, thin, platy structure; friable, slightly sticky; 10 percent coarse fragments; slightly acid; clear, wavy boundary.

A2—3 to 8 inches, brown (10YR 5/3) silt loam; weak, thin, platy structure; friable, slightly sticky; 10 percent coarse fragments; medium acid; clear, wavy boundary.

B1—8 to 13 inches, brown (10YR 5/3) silt loam; weak, medium, subangular blocky structure; friable, slightly sticky; 7 percent coarse fragments; medium acid; clear, wavy boundary.

B21t—13 to 20 inches, reddish-yellow (7.5YR 6/6) silty clay loam; moderate, coarse, subangular blocky structure; friable, sticky and plastic; thin clay films on peds; 10 percent coarse fragments; medium acid; clear, wavy boundary.

B22t—20 to 46 inches, brown (7.5YR 5/4) channery heavy silt loam; white (10YR 8/2) ped faces and interiors; many, coarse, prominent, white (10YR 8/2) and reddish-yellow (5YR 6/6) mottles; weak, coarse, prismatic structure parting to blocky; firm, slightly sticky; nearly continuous clay films on peds; 20 percent coarse fragments; slightly acid; gradual, wavy boundary.

C—46 to 60 inches, reddish-yellow (7.5YR 6/6) channery silt loam; massive; firm; common black concretions and coatings; 40 percent coarse fragments; slightly acid.

The solum ranges from 30 to 50 inches in thickness. Depth to bedrock ranges from 5 to 10 feet. The content of coarse fragments, dominantly diabase, ranges from less than 5 percent to 20 percent in the solum to 15 to 40 percent in the C horizon. The Bt horizon ranges from reddish yellow to brown. It is silt loam or silty clay loam. The C horizon ranges from silt loam to sandy loam.

Mount Lucas soils are in close association with well-drained Neshaminy soils and poorly drained Towhee soils. All these soils formed in similar parent material. Mount Lucas soils are also near Lehigh soils, but they do not have the metamorphosed shale fragments and inherited gray colors that are characteristic of Lehigh soils.

Mount Lucas silt loam, 0 to 3 percent slopes (MlA).—This soil is at the base of slopes. Areas are elongated and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is plowed instead of natural.

Included with this soil in mapping are some areas of similar soils that have a fragipan and some small areas of Towhee soils.

Most of this soil is used for crops. It is suited to moisture-tolerant field crops, grasses, and legumes. Alfalfa and winter grain are subject to damage from frost heaving.

The seasonal high water table and slow permeability limit most nonfarm uses of this soil. Capability unit IIw-2.

Mount Lucas silt loam, 3 to 8 percent slopes (MlB).—This soil is on middle and lower elevations on hills and ridges. Areas generally are elongated and 3 to 100 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is plowed instead of natural.

Included with this soil in mapping are some areas of similar soils that have a fragipan and some small areas of Towhee soils.

Most of this soil is used for crops. It is suited to moisture-tolerant field crops, grasses, and legumes. Alfalfa and winter grain are subject to damage from frost heaving.

The seasonal high water table and slow permeability limit most nonfarm uses of this soil. Capability unit IIe-5.

Mount Lucas silt loam, 8 to 15 percent slopes (MlC).—This soil is at the base of hills and ridges. Slopes are long. Areas generally are in bands around the hills and ridges and are 3 to 25 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is plowed instead of natural.

Included with this soil in mapping are some areas of eroded Mount Lucas soils that are missing almost all of the original surface layer and some areas of similar soils that have a fragipan.

Most of this soil is used for crops. It is suited to moisture-tolerant field crops, grasses, and legumes. Alfalfa and winter grain are subject to damage from frost heaving.

The seasonal high water table and slow permeability limit most nonfarm uses of this soil. Capability unit IIIe-5.

Mount Lucas extremely stony silt loam, 0 to 8 percent slopes (MoB).—This soil is at the base of hills and ridges. Areas generally are elongated and 5 to 200 acres or more in size. The profile of this soil is the one described as representative of the series. About 5 to 35 percent of the surface is covered by stones and some boulders.

Included with this soil in mapping are some areas of similar soils that have a fragipan.

Most of this soil is used as woodland. This soil has an extremely stony surface; therefore it is not suited to cultivation.

The seasonal high water table, slow permeability, and stoniness limit most nonfarm uses of this soil. Capability unit VIIs-2.

Mount Lucas extremely stony silt loam, 8 to 25 percent slopes (MoD).—This soil is on the lower third of long hillsides and sides of ridges. Areas generally are in bands around the hills and ridges and 5 to 200 acres or more in size. About 5 to 35 percent of the surface is covered with stones and some boulders.

Included with this soil in mapping are some areas of similar soils that have a fragipan.

Most of this soil is used as woodland. This soil has an extremely stony surface; therefore it is not suited to cultivation.

The seasonal high water table, slow permeability, slope, and stoniness limit most nonfarm uses of this soil. Capability unit VIIs-2.

Neshaminy Series

The Neshaminy series consists of deep, well-drained, nearly level to very steep soils on uplands. These soils are on hills, ridges, and side slopes. They formed in loamy material weathered chiefly from diabase.

In a representative profile in a wooded area, 2 inches of organic material covers the surface. The surface layer is very dark gray and dark-brown channery silt loam about 9 inches thick. The subsoil is 45 inches thick. The upper 9 inches is strong-brown channery silty clay loam; the lower 36 inches is strong-brown channery clay loam. The substratum is strong-brown heavy sandy loam that extends to a depth of 95 inches.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Available water capacity is high, and permeability is moderately slow. Restricted permeability, slope, and stoniness are limitations to most nonfarm uses of these soils.

Representative profile of Neshaminy channery silt loam, in a wooded area of Neshaminy extremely stony silt loam, 8 to 25 percent slopes, 1½ miles west of Keelersville:

O2—2 inches to 0, very dark gray (5YR 3/1) mat of partly decomposed organic matter, leaves, and twigs.

A1—0 to 4 inches, very dark gray (10YR 3/1) channery silt loam; moderate, fine, granular structure; very friable; 15 percent coarse fragments; slightly acid; clear, wavy boundary.

A2—4 to 9 inches, dark-brown (7.5YR 4/4) channery silt loam; moderate, fine, granular structure; friable; 15 percent coarse fragments; slightly acid; clear, wavy boundary.

B21t—9 to 18 inches, strong-brown (7.5YR 5/6) channery silty clay loam; moderate, coarse, subangular blocky structure; friable, sticky and plastic; thick nearly continuous clay films; 20 percent diabase fragments; slightly acid; clear, wavy boundary.

B22t—18 to 39 inches, strong-brown (7.5YR 5/6) channery clay loam; moderate, coarse, subangular blocky structure; firm, sticky and plastic; thick, nearly continuous clay films; 25 percent diabase fragments; many black coatings; slightly acid; gradual, wavy boundary.

B3—39 to 54 inches, strong-brown (7.5YR 5/6) channery clay loam; weak, coarse, subangular blocky structure; firm, slightly sticky and slightly plastic; few clay films; 35 percent diabase fragments; many black coatings; slightly acid; clear, wavy boundary.

C—54 to 95 inches, strong-brown (7.5YR 5/8) heavy sandy loam; massive; friable, slightly sticky and slightly plastic; 40 percent diabase fragments; slightly acid.

The solum ranges from 40 to 54 inches in thickness. Depth to bedrock ranges from 4 to 10 feet. The content of coarse fragments ranges from 10 to 45 percent in the A and Bt horizons and from 30 to 60 percent in the B3 and C horizons. The B horizon ranges from yellowish red to dark brown. It is silty clay loam, clay loam, and heavy loam and is medium acid to slightly acid.

Neshaminy soils are in close association with moderate well drained to somewhat poorly drained Mount Lucas soils and poorly drained Towhee soils. All these soils formed in similar parent material. Neshaminy soils are also near Lehigh soils, which do not have the inherited gray colors and the metamorphosed shale fragments typical of those soils.

Neshaminy channery silt loam, 3 to 8 percent slopes (NeB).—This soil is on ridgetops and hilltops. Areas are oval or elongated and 3 to 100 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is plowed instead of natural.

Included with this soil in mapping are some small areas of nearly level Neshaminy soils and a few areas of extremely stony Neshaminy soils.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area.

This soil has good drainage and gentle slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit IIe–2.

Neshaminy channery silt loam, 8 to 15 percent slopes (NeC).—This soil is on sides of hills and ridges. Areas generally are elongated and 3 to 100 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is plowed instead of natural.

Included with this soil in mapping are some small areas of eroded Neshaminy soils that are missing almost all of the original surface layer. Also included are a few small areas of moderately steep Neshaminy soils and a few small areas of extremely stony Neshamany soils.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area.

The slope limits most nonfarm uses of this soil. Capability unit IIIe–1.

Neshaminy extremely stony silt loam, 0 to 8 percent slopes (NhB).—This soil is on hilltops and ridgetops. Areas are oval or elongated and 5 to 200 acres in size. About 5 to 40 percent of the surface is covered with stones and boulders.

Included with this soil in mapping are some areas of similar extremely stony soils that have a solum less than 3 feet thick.

Most of this soil is used as woodland. This soil has an extremely stony surface; therefore it is not suited to cultivation.

Stoniness limits some nonfarm uses of this soil. Capability unit VIIs–1.

Neshaminy extremely stony silt loam, 8 to 25 percent slopes (NhD).—This soil is on sides of hills and ridges (fig. 28). Areas are elongated or irregular in shape and 5 to 300 acres or more in size. The profile of this soil is the one described as representative of the series. About 5 to 40 percent of the surface is covered with stones and boulders.

Included with this soil in mapping are some areas of similar extremely stony soils that have a solum less than 3 feet thick.

Most of this soil is used as woodland. This soil has an extremely stony surface; therefore it is not suitable for cultivation.

The slope and stoniness limit most nonfarm uses of this soil. Capability unit VIIs–1.

Neshaminy extremely stony silt loam, 25 to 50 percent slopes (NhE).—This soil is on sides of ridges. Areas are elongated and 10 to 200 acres or more in size. The profile of this soil is similar to the one described as representative of the series but the subsoil is slightly thinner.

Included with this soil in mapping are some areas of similar extremely stony soils that have a solum less than 3 feet thick. Also included are some areas of extremely stony soils that formed in material weathered from metamorphosed shale and sandstone.

Most of this soil is used as woodland. This soil is steep to very steep and has an extremely stony surface; therefore it is not suitable for cultivation.

The slope and stoniness limit most nonfarm uses of this soil. Capability unit VIIs–3.

Penn Series

The Penn series consists of moderately deep, well-drained, nearly level to very steep soils on uplands. These soils are on sides and tops of hills and ridges. They formed in loamy material weathered from red shale and sandstone.

In a representative profile in a cultivated area, the plow layer is dark reddish-brown silt loam about 6 inches thick. The subsoil is 21 inches thick. The upper 7 inches is reddish-brown silt loam; the lower 14 inches is dark reddish-brown and reddish-brown shaly silt loam. The substratum is reddish-brown very shaly silt loam 8 inches thick. Weak-red, fractured shale bedrock is at a depth of 35 inches.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Available water capacity is moderate to low, and permeability is moderate. The depth to bedrock and slope are limitations to most nonfarm uses of these soils.

Representative profile of Penn silt loam, 8 to 15 percent slopes, in a hayfield 50 feet east of St. Leonard Road, 2 miles southwest of Newton:

Ap—0 to 6 inches, dark reddish-brown (5YR 3/2) silt loam; moderate, very fine, granular structure; very friable; 8 percent shale fragments; medium acid; abrupt, wavy boundary.

B1—6 to 13 inches, reddish-brown (5YR 4/3) silt loam; weak, thin, platy structure parting to moderate, fine, subangular blocky; friable, slightly sticky; 10 percent shale fragments; strongly acid; clear, wavy boundary.

B22t—13 to 20 inches, dark reddish-brown (5YR 3/3) shaly silt loam; moderate, medium, subangular blocky structure; firm, slightly sticky; thin clay films on peds; 25 percent shale fragments; strongly acid; clear, wavy boundary.

B23t—20 to 27 inches, reddish-brown (2.5YR 4/4) shaly silt loam; weak, medium, subangular blocky structure; firm, slightly sticky and slightly plastic; thin clay films on peds; 40 percent shale fragments; strongly acid; gradual, wavy boundary.

Figure 28.—Wooded area of Neshaminy extremely stony silt loam, 8 to 25 percent slopes.

C—27 to 35 inches, reddish-brown (2.5YR 4/4) very shaly silt loam; massive; very firm; 75 percent shale fragments; strongly acid; gradual, wavy boundary.

R—35 inches +, weak-red (2.5YR 4/2), fractured shale bedrock.

The solum ranges from 20 to 32 inches in thickness. Depth to bedrock ranges from 20 to 40 inches. The content of coarse fragments ranges from less than 10 percent to 30 percent in the A horizon, from 20 to 45 percent in individual layers of the B horizon, and to more than 50 percent in the C horizon. The B horizon ranges from reddish brown to weak red. It is silt loam or loam and is naturally very strongly acid or strongly acid. The C horizon is strongly acid to slightly acid.

Penn soils are in close association with Readington, Abbottstown, and Doylestown soils. Those are deep soils that have a fragipan and impeded drainage. Penn soils are similar to Reaville soils but are not mottled in the horizon above the bedrock. Penn soils are also associated with Klinesville soils but are deeper to bedrock.

Penn silt loam, 0 to 3 percent slopes (PeA).—This soil has uniform slopes and occurs on ridgetops and hilltops. Areas are oval to elongated and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is slightly thicker and fewer coarse fragments are in the surface layer and subsoil.

Included with this soil in mapping are some small areas of Klinesville and Reaville soils.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area, but droughtiness is a limitation. The depth to fractured bedrock limits most nonfarm uses of this soil. Capability unit IIs–1.

Penn silt loam, 3 to 8 percent slopes (PeB).—This soil is on upper convex sides of hills and ridges. Areas are elongated and 3 to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is slightly thicker.

Included with this soil in mapping are some small areas of eroded Penn soils that are missing all the original surface layer. Also included are small areas of Klinesville and Reaville soils.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area, but droughtiness is a limitation.

The depth to fractured bedrock limits most nonfarm uses of ths soil. Capability unit IIe–4.

Penn silt loam, 8 to 15 percent slopes (PeC).—This soil is on convex sides of hills and ridges. Areas are elongated and 3 to 25 acres or more in size. The profile of

this soil is the one described as representative of the series.

Included with this soil in mapping are some areas of eroded Penn soils that are missing all the original surface layer and some areas of Penn soils that are stony. Also included are small areas of Klinesville and Reaville soils.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area, but droughtiness is a limitation. The depth to fractured bedrock and slope limit most nonfarm uses of this soil. Capability unit IIIe-3.

Penn silt loam, 15 to 25 percent slopes (PeD).—This soil is on convex sides of hills and ridges. Areas are elongated and 5 to 20 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsoil are slightly thinner.

Included with this soil in mapping are some areas of eroded Penn soils that are missing all the original surface layer and some areas of Penn soils that are stony. Also included are small areas of Klinesville soil.

Most of this soil is used for hay or pasture. Under good management it is suited to limited cultivation and to pasture or hay. The slope and depth to fractured bedrock limit most nonfarm uses of this soil. Capability unit IVe-2.

Penn-Klinesville shaly silt loams, 3 to 8 percent slopes, eroded (PhB3).—This complex is about 60 percent Penn shaly silt loam, 35 percent Klinesville shaly silt loam, and 5 percent included soils. These soils are on upper convex sides of hills and ridges. Areas are irregular in shape and 3 to 100 acres in size. The profiles of these soils are similar to those described as representative of their respective series, but all of the original surface layer is missing through erosion and more coarse fragments are in both these soils.

Included with these soils in mapping are small areas of Reaville soils. Also included are some areas of soils that are similar to Klinesville soils but are only about 6 to 10 inches deep over fractured shale bedrock, and a few areas of soils that are similar to Penn soils, but the solum is less than 20 inches thick.

Most of these soils are used for crops. Under good management they are suited to cultivation and to hay or pasture.

The depth to bedrock limits most nonfarm uses of these soils. Capability unit IIIe-4.

Penn-Klinesville complex, 8 to 15 percent slopes, eroded (PkC3).—This complex is about 55 percent Penn shaly silt loam, 40 percent Klinesville soils, and 5 percent included soils. These soils are on the upper sides of hills and ridges. Areas are irregular in shape and 3 to 50 acres in size. The profiles of these soils are similar to those described as representative of their respective series, but all of the original surface layer is missing through erosion and the content of coarse fragments is greater.

Included with these soils in mapping are small areas of Reaville soils. Also included are areas of some soils similar to Klinesville soil that are only about 6 to 10 inches deep over fractured shale bedrock.

Most of these soils are used for crops or pasture. They are suited to limited cultivation under good management and to hay or pasture.

The depth to bedrock limits most nonfarm uses of these soils. Capability unit IVe-3.

Penn-Klinesville extremely stony silt loams, 8 to 25 percent slopes (PlD).—This complex is about 60 percent Penn extremely stony silt loam, 35 percent Klinesville extremely stony silt loam, and 5 percent included soils. These soils are on hills and ridges or are in areas that have short slopes and are adjacent to drainageways or streams. Areas are elongated and 5 to 100 acres in size. The profiles of these soils are similar to those described as representative of their respective series, but the surface layer is natural instead of plowed. About 5 to 20 percent of the surface is covered with stones.

Included with these soils in mapping are some areas of extremely stony Penn soils that are nearly level to gently sloping. Also included are some soils similar to Klinesville soils that are less than 10 inches deep to bedrock.

Most of these soils are used as woodland. These soils have an extremely stony surface and are not suited to cultivation.

The slope, stoniness, and depth to bedrock are limitations to most nonfarm uses of these soils. Capability unit VIIs-1.

Penn-Klinesville extremely stony silt loams, 25 to 50 percent slopes (PlE).—This complex is about 55 percent Penn extremely stony silt loam, 40 percent Klinesville extremely stony silt loam, and 5 percent included soils. These soils are on ridges or are in areas that have short slopes and are adjacent to drainageways or streams. Areas are elongated and 5 to 200 acres in size. The profiles of these soils are similar to those described as representative of their respective series, but the surface layer is natural instead of plowed. About 5 to 20 percent of the surface is covered with stones.

Included with these soils in mapping are some areas of Klinesville shaly silt loam that is missing all of the surface layer through erosion. Also included are some areas of soils similar to Klinesville soils that are less than 10 inches deep to bedrock and small areas of rock outcrop that is mainly ledges.

Most of these soils are used as woodland. These soils have excessive slopes and an extremely stony surface and are not suited to cultivation.

The slope, stoniness, and depth to bedrock limit most nonfarm uses of these soils. Capability unit VIIs-3.

Penn-Lansdale complex, 3 to 8 percent slopes (PnB).—This complex is about 55 percent Penn silt loam and Penn shaly silt loam, 40 percent Lansdale loam, and 5 percent included soils. These soils are on upper sides of hills and ridges. Areas are irregular in shape and 3 to 200 acres in size. The profiles of these soils are similar to those described as representative of their respective series, but the surface layer is thicker and fewer coarse fragments are in the Penn soils.

Included with these soils in mapping are some areas of Penn and Lansdale soils that have lost all of the original surface layer through erosion. Also included

are some small areas of Bedington silt loam, Culleoka shaly silt loam, Klinesville very shaly silt loam, and Weikert shaly silt loam.

Most of these soils are used for crops. They are suited to most cultivated crops commonly grown in the area.

The depth to fractured bedrock in the Penn soils limits most nonfarm uses of this complex. Capability unit IIe-4.

Penn-Lansdale complex, 8 to 15 percent slopes (PnC).—This complex is about 55 percent Penn silt loam and shaly silt loam, 40 percent Lansdale loam, and 5 percent included soils. These soils are on sides of hills and ridges. Areas are irregular in shape and 3 to 100 acres in size. The profiles of these soils are similar to those described as representative of their respective series, but the surface layer and subsoil are slightly thinner in the Lansdale soil.

Included with these soils in mapping are some areas of Penn and Lansdale soils that have lost all of their original surface layer through erosion. Also included are some small areas of Bedington silt loam, Culleoka shaly silt loam, Klinesville very shaly silt loam, and Weikert shaly silt loam.

Most of these soils are used for crops. They are suited to most cultivated crops commonly grown in the area.

The depth to fractured bedrock in the Penn soils and slope limit most nonfarm uses of this complex. Capability unit IIIe-3.

Pope Series

The Pope series consists of deep, well-drained, nearly level to gently sloping soils on flood plains and terraces. These soils are adjacent to or very near the Delaware River (fig. 29). They formed chiefly in loamy alluvial sediment derived from weathered shale, sandstone, quartz, and limestone.

In a representative profile in a cultivated area, the plow layer is dark-brown loam about 10 inches thick. The subsoil is 39 inches thick. The upper 13 inches is brown loam and very fine sandy loam; the lower 26 inches is brown and dark yellowish-brown fine sandy loam. The substratum is dark yellowish-brown and dark grayish-brown very gravelly loamy sand and gravelly sand that extends to a depth of 80 inches.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. Available water capacity is high, and permeability is moderately rapid. Flooding is a limitation to most nonfarm uses of these soils.

Figure 29.—**Nearly level area of Pope loam on the Delaware River flood plain. Soils in background are Penn-Klinesville extremely stony silt loams.**

Representative profile of Pope loam, 0 to 5 percent slopes, in a nursery one-half mile north of Erwinna. This is the soil S68Pa-09-1(1-9) sampled for characterization analysis in tables 12 and 13.

Ap—0 to 10 inches, dark-brown (10YR 3/3) loam; weak, thin, platy structure parting to weak, very fine, subangular blocky; friable; strongly acid; abrupt, smooth boundary.

B1—10 to 14 inches, brown (7.5YR 4/4) loam; weak, thin, platy structure; friable, slightly sticky and slightly plastic; medium acid; clear, wavy boundary.

B21—14 to 19 inches, brown (7.5YR 4/4) very fine sandy loam; weak, medium, subangular blocky structure; friable, slightly sticky; medium acid; clear, wavy boundary.

B22—19 to 23 inches, brown (7.5YR 4/4) very fine sandy loam; weak, medium, subangular blocky structure; friable, slightly sticky; medium acid; clear, wavy boundary.

B23—23 to 27 inches, brown (7.5YR 4/4) fine sandy loam; weak, coarse, subangular blocky structure; very friable; medium acid; gradual, wavy boundary.

B24—27 to 37 inches, brown (7.5YR 4/4) fine sandy loam; very weak, medium, platy structure; very friable; medium acid; diffuse, wavy boundary.

B3—37 to 49 inches, dark yellowish-brown (10YR 4/4) light fine sandy loam; very weak, medium, platy structure; very friable; medium acid; clear, wavy boundary.

IIC1—49 to 61 inches, dark yellowish-brown (10YR 4/4) very gravelly loamy sand; single grained; very friable; 50 percent gravel; medium acid; clear, wavy boundary.

IIC2—61 to 80 inches, dark grayish-brown (10YR 4/2) gravelly coarse sand; single grained; very friable; 45 percent gravel; slightly acid.

The solum ranges from 40 to 50 inches in thickness. Depth to bedrock is more than 5 feet. The B horizon ranges from brown to dark yellowish brown. It is loam to fine sandy loam and medium acid to slightly acid. The content of gravel in the IIC horizon ranges from 35 to 65 percent.

Pope soils in Bucks and Philadelphia Counties have a slightly higher reaction and contain more coarse fragments in the C horizon than is defined in the range for the series, but these differences do not alter the use, management, or behavior of these soils.

Pope soils are in close association with Alton soils on the flood plains and Howell soils on terraces of the Coastal Plain. Pope soils contain less gravel in the A and B horizons than Alton soils and contain less clay than Howell soils.

Pope loam, 0 to 5 percent slopes (PoA).—This soil is on flood plains along the Delaware River. Areas are elongated and 3 to 50 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some areas of similar soils that are moderately well-drained. Also included are some small areas of Alton gravelly loam, flooded.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area. This soil is subject to flooding during periods of intense rain.

The hazard of flooding limits most nonfarm uses of this soil. Capability unit IIw-1.

Pope loam, terrace, 0 to 3 percent slopes (PpA).—This soil is mainly on broad, low terraces in the Delaware River Valley. It lies above the present level of flooding. Areas are irregular and 3 to 50 acres in size.

Included with this soil in mapping are some areas of similar soils that have a fine sandy loam subsoil and are moderately well drained. Also included are a few small areas of Alton gravelly loam.

Most of this soil is used for crops. Some areas are idle and are designated for urban development. This soil is suited to most cultivated crops commonly grown in the area.

This soil has good drainage and nearly level slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit I-1.

Pope loam, terrace, 3 to 10 percent slopes (PpB).—This soil is on terraces in the Delaware River Valley. It lies above the present level of flooding. Areas are irregular in shape and 3 to 20 acres in size. The profile of this soil is similar to the one described as representative of the series, but shale and sandstone are at a depth below 40 inches.

Included with this soil in mapping are some areas of similar soils that are less than 40 inches thick and are underlain by material weathered from shale and limestone.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area.

This soil has good drainage and gentle slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit IIe-1.

Readington Series

The Readington series consists of deep, moderately well drained, nearly level to sloping soils on uplands. These soils are on all positions of the slope, even broad ridgetops. They formed in loamy material weathered chiefly from shale, siltstone, and sandstone.

In a representative profile in a cultivated area, the plow layer is dark-brown silt loam about 8 inches thick. The subsoil is 42 inches thick. The upper 16 inches is reddish-brown heavy silt loam; the lower 26 inches is firm, brittle, reddish-brown silty clay loam that has white, pinkish-white, and pale-red mottles. The substratum is reddish-brown very shaly clay loam 10 inches thick. Fractured, dusky-red shale bedrock is at a depth of 60 inches.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. Available water capacity is moderate, and permeability is moderately slow. The water table generally rises to within 18 to 36 inches of the surface during wet seasons. Restricted permeability and wetness are limitations to most nonfarm uses of these soils.

Representative profile of Readington silt loam, 0 to 3 percent slopes, in a hayfield 2 miles west of Pipersville:

Ap—0 to 8 inches, dark-brown (7.5YR 3/2) silt loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

B2t—8 to 24 inches, reddish-brown (2.5YR 4/4) heavy silt loam; moderate, coarse, subangular blocky structure; friable, sticky and plastic; thin, nearly continuous clay films on peds; 3 percent shale fragments; very strongly acid; clear, wavy boundary.

Bx1—24 to 34 inches, reddish-brown (5YR 4/3) silty clay loam; common, medium, distinct, pale-red (2.5YR 6/2) and white (5YR 8/1) mottles; weak, very coarse, prismatic structure parting to very thick, platy; firm and brittle, sticky and plastic; thick, nearly continuous clay films on plates; 7 percent shale fragments; very strongly acid; clear, wavy boundary.

Bx2—34 to 50 inches, reddish-brown (5YR 4/3) shaly silty clay loam; many, coarse, distinct, pinkish-white (7.5YR 8/2) and pale-red (2.5YR 6/2) mottles; weak, very thick, platy structure; firm and brittle, sticky and plastic; occasional clay films in pores; 20 percent shale fragments; very strongly acid; gradual, wavy boundary.

C—50 to 60 inches, reddish-brown (5YR 4/3) very shaly clay loam; massive; firm, sticky and plastic; 50 percent shale fragments; strongly acid; clear, wavy boundary.

R—60 inches +, dusky red (2.5YR 3/2), fractured shale bedrock.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock ranges from 42 to 70 inches. Depth to the fragipan ranges from 24 to 36 inches. The content of shale, quartzite, siltstone, and sandstone coarse fragments ranges from 0 to 20 percent in the A and Bt horizons, from 5 to 30 percent in the Bx horizon, and from 30 to 60 percent or more in the C horizon. The B horizon ranges from reddish brown to brown. It is heavy silt loam, silty clay loam, and clay loam. Low-chroma mottling begins at a depth below 20 inches. The B horizon is medium acid to very strongly acid, and the C horizon ranges from strongly acid to slightly acid.

Readington soils are in close association with moderately deep Penn soils and deep Lansdale and Bedington soils, but the Readington soils have a fragipan and are not so well drained as those soils. The moderately well drained Readington soils are in a drainage sequence with somewhat poorly drained Abbottstown soils and poorly drained Doylestown soils.

Readington silt loam, 0 to 3 percent slopes (RdA).—This soil is in valleys and on broad ridgetops. Areas are irregular in shape and 3 to 100 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the solum is slightly thicker.

Included with this soil in mapping are some small areas of Abbottstown and Reaville soils. Also included are about 600 acres of soils similar to Readington soils, but they contain a high percentage of quartzite gravel. They are mainly in the area north of Milford Square.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area. Alfalfa and winter grain are subject to damage from frost heaving.

The seasonal high water table and moderately slow permeability limit most nonfarm uses of this soil. Capability unit IIw–2.

Readington silt loam, 3 to 8 percent slopes (RdB).—This soil is in valleys and on low ridges. Areas are elongated or irregular in shape and 3 to 50 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some small areas of Abbottstown and Reaville soils. Also included are about 600 acres of soils similar to Readington soils, except that they contain a high percentage of quartzite gravel. They are mainly in the area north of Milford Square.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area. Alfalfa and winter grain are subject to damage from frost heaving.

The seasonal high water table and moderately slow permeability limit most nonfarm uses of this soil. Capability unit IIe–5.

Readington silt loam, 8 to 15 percent slopes (RdC).—This soil is on sides of hills and ridges. Areas are elongated and 3 to 25 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the solum is slightly thinner and the content of coarse fragments is greater.

Included with this soil in mapping are a few areas of eroded Readington soils that are missing almost all of the original surface layer. Also commonly included are areas of Reaville and Abbottstown soils.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area. Alfalfa and winter grain are subject to damage from frost heaving.

The seasonal high water table and moderately slow permeability limit most nonfarm uses of this soil. Capability unit IIIe–5.

Reaville Series

The Reaville series consists of moderately deep, moderately well drained to somewhat poorly drained, nearly level to sloping soils on uplands. These soils are on broad ridgetops and side slopes. They formed in loamy material weathered from red and brown shale.

In a representative profile in a cultivated area, the plow layer is dark reddish-brown shaly silt loam about 6 inches thick. The subsoil is reddish-brown shaly and very shaly silt loam 16 inches thick. It has pink and pinkish-white mottles in the lower 10 inches. The substratum is mottled, reddish-brown very shaly silt loam 4 inches thick. Red fractured shale bedrock is at a depth of 26 inches.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. Available water capacity is low, and permeability is slow. The water table generally rises to within 12 to 24 inches of the surface during wet seasons. The depth to bedrock, restricted permeability, and wetness are limitations to nonfarm uses of these soils.

Representative profile of Reaville shaly silt loam, 3 to 8 percent slopes, in a pasture 50 feet west of Rolling Hills Road, in Bedminster Township:

Ap—0 to 6 inches, dark reddish-brown (5YR 3/3) shaly silt loam; weak, fine, granular structure; friable; 20 percent shale fragments; strongly acid; abrupt, smooth boundary.

B21t—6 to 12 inches, reddish-brown (5YR 5/3) shaly heavy silt loam; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; thin, nearly continuous clay films on peds; 45 percent shale fragments; strongly acid; clear, wavy boundary.

B22t—12 to 22 inches, reddish-brown (5YR 5/4) very shaly silt loam; common, medium, prominent, pink (5YR 7/3) and pinkish-white (7.5YR 8/2) mottles; weak, coarse, prismatic structure parting to weak, fine, subangular blocky; slightly firm, slightly sticky; thin, nearly continuous clay films on peds; 50 percent shale fragments; strongly acid; clear, wavy boundary.

C—22 to 26 inches, reddish-brown (5YR 5/4) very shaly silt loam; common, medium, prominent, pink (5YR 7/3) and pinkish-white (7.5YR 8/2) mottles; massive; firm, slightly sticky; 60 percent shale fragments; strongly acid; gradual, wavy boundary.

R—26 inches +, dusky red (10R 3/3), fractured shale bedrock.

The solum ranges from 15 to 24 inches in thickness. Depth to bedrock ranges from 20 to 32 inches. The content of shale

fragments ranges from 15 to 30 percent in the Ap horizon, from 35 to 50 percent in the B horizon, and from 50 to 75 percent in the C horizon. The B horizon is weak red, reddish brown, or red. Reaction is strongly acid or medium acid.

Reaville soils in Bucks and Philadelphia Counties have a weighted average of 35 to 50 percent shale fragments. This percentage is higher than is defined in the range for the series, but this difference does not alter the use, management, or behavior of the Reaville soils.

Reaville soils are in close association with Readington, Abbottstown, and Doylestown soils but are not so deep as those soils that have a fragipan and impeded drainage. Reaville soils also are associated with well-drained Penn and Klinesville soils.

Reaville shaly silt loam, 0 to 3 percent slopes (ReA).—This soil is on broad ridgetops. Areas are oval or elongated and 3 to 150 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but it has fewer coarse fragments.

Included with this soil in mapping are small areas of Klinesville, Penn, Abbottstown, and Readington soils.

Most of this soil is used for crops. The choice of crops that can be grown successfully, however, is limited.

The depth to bedrock, the seasonal high water table, and slow permeability limit most nonfarm uses of this soil. Capability unit IIIw-3.

Reaville shaly silt loam, 3 to 8 percent slopes (ReB).—This soil is on sides of low hills and ridges. Areas are elongated or irregular in shape and 3 to 200 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some areas of Penn, Klinesville, Abbottstown, and Readington soils. Also included are some areas of similar soils that have shale bedrock at a depth of less than 20 inches.

Most of this soil is used for crops. The choice of crops that can be grown successfully, however, is limited.

The depth to bedrock, the seasonal high water table, and slow permeability limit most nonfarm uses of this soil. Capability unit IIIw-3.

Reaville shaly silt loam, 8 to 15 percent slopes (ReC).—This soil is on sides of low hills and ridges. Areas are elongated and 3 to 200 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsoil are thinner.

Included with this soil in mapping are some areas of Penn and Klinesville soils. Also included are some similar soils that have shale bedrock at a depth of less than 20 inches.

Most of this soil is used for crops and pasture. The choice of crops that can be grown successfully, however is limited.

The depth to bedrock, the seasonal high water table, and slow permeability limit most nonfarm uses of this soil. Capability unit IVe-4.

Rowland Series

The Rowland series consists of deep, moderately well drained to somewhat poorly drained, nearly level soils on flood plains. These soils are mainly along small meandering streams (fig. 30). They formed in loamy alluvium that washed from upland soils and is underlain by red and brown shale and sandstone.

In a representative profile in a pasture, the plow layer is dark reddish-brown silt loam about 16 inches thick. The subsoil is 26 inches thick. The upper 14 inches is reddish-brown light silty clay loam that has many, reddish-gray and yellowish-red mottles; the lower 12 inches is reddish-gray light silty clay loam that has strong-brown and pinkish-gray mottles. The substratum is pinkish-gray fine sandy loam and loamy fine sand that has yellowish-red mottles and extends to a depth of 62 inches.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is high, and permeability is moderately slow. The water table rises to within 12 to 24 inches of the surface during wet seasons. Flooding, restricted permeability, and wetness are limitations to most nonfarm uses of these soils.

Representative profile of Rowland silt loam, in a pasture 50 feet south of Pine Run and $1\frac{1}{2}$ miles northwest of Doylestown:

Ap1—0 to 9 inches, dark reddish-brown (5YR 3/3) silt loam; weak, very fine, granular structure; friable; medium acid; abrupt, wavy boundary.

Ap2—9 to 16 inches, dark reddish-brown (5YR 3/3) silt loam; moderate, thin, platy structure; friable; medium acid; abrupt, wavy boundary.

B21—16 to 30 inches, reddish-brown (5YR 5/3) light silty clay loam; many, medium, faint, reddish-gray (5YR 5/2) and yellowish-red (5YR 4/6) mottles; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky; firm, sticky and plastic; medium acid; clear, wavy boundary.

B22—30 to 42 inches, reddish-gray (5YR 5/2) light silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/6) and pinkish-gray (5YR 7/2) mottles; weak, very thick, platy structure parting to medium subangular blocky; friable, slightly sticky and slightly plastic; few thin silt films; medium acid; abrupt, wavy boundary.

IIC1g—42 to 54 inches, pinkish-gray (5YR 7/2) fine sandy loam; common, medium, prominent, yellowish-red (5YR 5/8) mottles; very weak, coarse, subangular blocky structure; friable; medium acid; clear, wavy boundary.

IIC2g—54 to 62 inches, pinkish-gray (7.5YR 7/2) loamy fine sand; many, coarse, prominent, yellowish-red (5YR 4/6) mottles; very weak, coarse, subangular blocky structure; friable; medium acid.

The solum ranges from 30 to 40 inches in thickness. Depth to stratified sand and gravel is more than 40 inches. Depth to bedrock ranges from $3\frac{1}{2}$ feet to 6 feet or more. Reaction throughout the profile ranges from very strongly acid to medium acid. The B horizon ranges from brown to reddish brown in the upper part and from reddish gray to reddish brown in the lower part. It ranges from sandy clay loam to silt loam.

The moderately well drained to somewhat poorly drained Rowland soils are in close association with poorly drained Bowmansville soils.

Rowland silt loam (0 to 3 percent slopes) (Ro).—This soil is on flood plains along the creeks in areas of shale and sandstone. Areas are long and narrow and 3 to 50 acres in size.

Included with this soil in mapping are some areas of similar flood-plain soils that are well drained. Also included are some areas of moderately well drained flood-plain soils that formed in alluvium washed from upland soils underlain by gneiss, schist, and limestone.

Most of this soil is used for crops or pasture. Where areas are large enough and flooding is late in winter and early in spring, nearly all cultivated crops commonly grown in the area are suited.

Figure 30.—One of Bucks County's historic covered bridges in an area of Rowland silt loam on a narrow flood plain.

Flooding, the seasonal high water table, and moderately slow permeability limit most nonfarm uses of this soil. Capability unit IIw-1.

Steinsburg Series

The Steinsburg series consists of moderately deep, well-drained, gently sloping to moderately steep soils on uplands. These soils are on slopes and tops of hills. They formed in loamy material weathered chiefly from sandstone and conglomerate.

In a representative profile in a cultivated area, the plow layer is brown gravelly loam about 8 inches thick. The subsoil is brown sandy loam 7 inches thick. The substratum is yellowish-red gravelly sandy loam 15 inches thick. Brownish-yellow sandstone conglomerate bedrock is at a depth of 30 inches.

Runoff is medium, and the hazard of erosion is moderate to high. Available water capacity is low, and permeability is moderately rapid. The depth to bedrock and the slope are limitations to most nonfarm uses of these soils.

Representative profile of Steinsburg gravelly loam, 3 to 8 percent slopes, in a cultivated field 50 feet southeast of local road 350, 2½ miles southeast of Doylestown:

Ap—0 to 8 inches, brown (7.5YR 4/2) gravelly loam; weak, fine, granular structure; friable; 15 percent quartzite gravel weathered from conglomerate; strongly acid; abrupt, smooth boundary.

B—8 to 15 inches, brown (7.5YR 4/4) sandy loam; weak, fine, subangular blocky structure; friable; partial clay bridging; 10 percent quartzite gravel; strongly acid; clear, wavy boundary.

C—15 to 30 inches, yellowish-red (5YR 5/6) gravelly sandy loam; massive; friable; 40 percent coarse fragments; strongly acid; clear, wavy boundary.

R—30 inches +, brownish-yellow (10YR 6/6) arkosic sandstone conglomerate; very strongly acid.

The solum ranges from 12 to 20 inches in thickness. Depth to conglomerate bedrock ranges from 24 to 40 inches. The content of coarse fragments ranges from 5 to 20 percent in the solum and from 25 to 60 percent in the C horizon. Reaction is strongly acid or very strongly acid. The B horizon and C horizon range from yellowish red to yellowish brown and are loam and sandy loam.

Steinsburg soils are in close association with deep, well-drained Lansdale soils on uplands and are in the same area as Readington, Abbottstown, and Doylestown soils. Steinsburg soils are coarser textured, have less distinct horizonation, and are shallower over bedrock than all those associated soils.

Steinsburg gravelly loam, 3 to 8 percent slopes (StB).—This soil is on hilltops. Areas are elongated and 3 to 100 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are small areas of gravelly Lansdale soils. Also included are areas of eroded Steinsburg soils that are missing almost all the original surface layer.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area.

The depth to bedrock limits most nonfarm uses of this soil. Capability unit IIe–4.

Steinsburg gravelly loam, 8 to 15 percent slopes (StC).—This soil is on sides of hills. Areas are elongated to 50 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the content of coarse fragments is slightly more.

Included with this soil in mapping are small areas of gravelly Lansdale soils and some areas of soils similar to Steinsburg soils that have bedrock at a depth of more than 40 inches. Also included are some areas of eroded Steinsburg soils that are missing almost all of the original surface layer.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area.

The depth to bedrock limits most nonfarm uses of this soil. Capability unit IIIe–3.

Steinsburg gravelly loam, 15 to 25 percent slopes (StD).—This soil is on convex side slopes. Areas are in elongated bands and are 3 to 50 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsoil are thinner.

Included with this soil in mapping are some areas of eroded Steinsburg soils that are missing all the original surface layer. Also included are some areas of similar soils that have bedrock at a depth of more than 40 inches.

Most of this soil is used for hay and pasture. It is suited to hay and pasture and to limited cultivation under good management.

The depth to bedrock and slope limit most nonfarm uses of this soil. Capability unit IVe–2.

Towhee Series

The Towhee series consists of deep, poorly drained, nearly level to gently sloping soils on uplands. These soils are in concave positions at the base of slopes and in depressions. They formed in loamy material weathered chiefly from diabase.

In a representative profile in an idle field, the plow layer is brown silt loam about 8 inches thick. The subsoil is 55 inches thick. The upper 20 inches is light brownish-gray silt loam and gravelly silty clay loam and grayish-brown silty clay loam that has distinct, light-gray, strong-brown, yellowish-brown, brown, and yellowish-red mottles. The lower 35 inches is yellowish-red silt and strong brown loam mottled with dark gray and yellowish red. It is compact, firm and brittle, and has prismatic and blocky structure. The substratum is reddish-yellow and pale-yellow coarse sandy loam that contains many gray to yellowish-red mottles and extends to a depth of 76 inches.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is high, and permeability is slow. The water table generally rises to the surface during wet seasons. The restricted permeability, wetness, and stoniness are limitations to most nonfarm uses of these soils.

Representative profile of Towhee silt loam, 0 to 3 percent slopes, in an idle field in State game lands, six-tenths mile northeast of intersection of Route 09130 and unimproved game land road, in Haycock Township. This is the soil S68Pa–09–12(1–9) sampled for characterization analysis in tables 12 and 13:

Ap—0 to 8 inches, brown (10YR 5/3) silt loam; few stains of dark yellowish brown (10YR 3/4); weak, fine, granular structure; friable; 10 percent diabase gravel; slightly acid; abrupt, wavy boundary.

B21tg—8 to 11 inches, light brownish-gray (2.5YR 6/2) silt loam; common, fine, distinct, light-gray (5Y 6/1) and strong-brown (7.5YR 5/8) mottles; weak, fine, blocky structure; friable, sticky and plastic; few thin clay films in pores; slightly acid; clear, wavy boundary.

B22tg—11 to 21 inches, light brownish-gray (2.5Y 6/2) gravelly silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/8) and strong-brown (7.5YR 5/8) mottles; very coarse, prismatic structure parting to weak, fine, blocky; friable, sticky and plastic; continuous clay films on facing peds; 20 percent diabase gravel; slightly acid; clear, irregular boundary.

B23tg—21 to 28 inches, grayish-brown (2.5Y 5/2) silty clay loam; common, medium, prominent, yellowish-red (5YR 5/8) and brown (7.5YR 4/2) mottles; very coarse, prismatic structure parting to weak, medium, blocky; firm, sticky and plastic; continuous clay films on peds and in pores; few black iron and manganese coatings; 10 percent diabase gravel; neutral; clear, wavy boundary.

Bx1—28 to 53 inches, yellowish-red (5YR 4/8) silt loam; gray (N 6/0) prism faces; common, coarse, distinct, dark-gray (5YR 4/1) and yellowish-red (5YR 5/8) mottles; weak, very coarse, prismatic structure parting to weak, coarse, subangular blocky; firm and brittle, slightly sticky and slightly plastic; thin, continuous clay films on faces of peds; 10 percent diabase gravel; neutral; gradual, wavy boundary.

Bx2—53 to 63 inches, strong-brown (7.5YR 5/6) loam; grayish-brown (2.5Y 5/2) prism faces; few, coarse, distinct, dark-gray (5YR 4/1) and yellowish-red (5YR 5/8) mottles; weak, very coarse, prismatic structure parting to weak, coarse, subangular blocky; very firm, sticky and plastic; few thin clay films; 5 percent diabase gravel; neutral; abrupt, wavy boundary.

C1—63 to 69 inches, reddish-brown (7.5YR 7/6) coarse sandy loam that has clay pockets; many, coarse, distinct, gray (N 6/0) and reddish-yellow (7.5YR 6/6) mottles; massive; firm, sticky; few thick clay films in pores; 10 percent diabase gravel; neutral; clear, wavy boundary.

C2—69 to 76 inches, pale-yellow (2.5Y 7/4) coarse sandy loam; many, coarse, prominent, light-gray (5Y 7/1) and yellowish-red (5YR 5/8) mottles; massive; firm, slightly sticky; some clay bridging between sand grains; 10 percent diabase gravel; neutral.

The solum ranges from 40 to 70 inches in thickness. Depth to bedrock is 4 to 8 feet. Depth to the fragipan ranges from 20 to 30 inches. The content of coarse fragments, mainly diabase, ranges from less than 5 to 10 percent, by volume, in the Ap horizon and upper part of the Bt horizon and from 10 to 30 percent in the lower part of the Bt horizon and the Bx and C horizons. Reaction ranges from slightly acid to neutral. The Bt horizon ranges from light brownish gray to dark gray. It ranges from silt loam to light clay loam. Prism faces of the Bx horizon are gray to light brownish gray, and ped interiors range from brown to yellowish red. The Bx horizon ranges from loam to light silty clay loam. Sand increases and silt decreases with increasing depth. The C horizon ranges from sandy loam to clay loam.

Towhee soils are in close association with Mount Lucas and Neshaminy soils and formed in similar material, but Towhee soils are more poorly drained and have a fragipan that the associated soils do not. The Towhee soils are near Lehigh soils that have inherited gray colors and contain metamorphosed shale fragments.

Towhee silt loam, 0 to 3 percent slopes (ToA).—This soil is in depressions and at the base of hills and ridges. Areas are irregular in shape and 5 to 200 acres or more in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are small areas of similar soils that are very poorly drained. Also included are some small areas of Towhee extremely stony silt loam.

Most of this soil is used for pasture or is idle. It is generally too wet for cultivated crops.

The high water table and slow permeability limit most nonfarm uses of this soil. Capability unit IVw–2.

Towhee silt loam, 3 to 8 percent slopes (ToB).—This soil is along poorly defined drainageways and at the base of slopes. Areas are irregular in shape and 3 to 200 acres or more in size.

Included with this soil in mapping are some small areas of Towhee extremely stony silt loam.

Most of this soil is used for pasture or is idle. It is generally too wet for cultivated crops.

The high water table and slow permeability limit most nonfarm uses of this soil. Capability unit IVw–2.

Towhee extremely stony silt loam, 0 to 8 percent slopes (TwB).—This soil is in concave positions at the base of hills and ridges. Areas are irregular in shape and 5 to 500 acres or more in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thin and natural instead of plowed. About 5 to 35 percent of the surface is covered with stones and boulders (fig. 31).

Figure 31.—Area of Towhee extremely stony silt loam, 0 to 8 percent slopes, in woodland.

Included with this soil in mapping are some areas of similar soils that are more silty and contain angular rather than rounded stones.

Most of this soil is used as woodland. It is too wet and stony to be cultivated.

The high water table, slow permeability, and stoniness limit most nonfarm uses of this soil. Capability unit VIIs–4.

Urban Land

Urban land is in highly built-up areas of Bucks and Philadelphia Counties. Most Urban land is on terraces of the uplands and Coastal Plain; however, some is on the flood plain. The soils and foundation materials are highly variable. Urban structures and works cover so much of this land type that identification of the soils is not practical. Most areas have been smoothed, and the original soil material has been disturbed, filled over, or otherwise destroyed prior to construtcion.

Urban land is used for homesites, shopping centers, schools, factories, roads, cemeteries, golf courses, railroads, and other industrial facilities. The southern part of Bucks County and nearly all of Philadelphia County have the largest concentration of Urban land.

Urban land (0 to 8 percent slopes) (Ub).—This land type is in various positions on the uplands, on terraces on the Coastal Plain, and on the flood plain. Areas are irregular in shape and 5 to 1,000 acres or more in size.

Included in mapping are some areas of fill land of various sorts that are not built up. The largest areas of fill are along the Delaware River and in south Philadelphia.

The use of Urban land as a site for builtup areas precludes use for most other purposes. Capability unit unassigned.

Urban land-Abbottstown complex (0 to 8 percent slopes) (Uc).—This complex is about 60 percent Urban land, 35 percent Abbottstown silt loam, and 5 percent included soils. It is in semi-built-up areas that are mainly underlain by shale bedrock. Areas are irregular in shape and 5 to 700 acres in size.

Included with this complex in mapping are some areas of Readington, Doylestown, Chalfont, Penn, Bowmansville, and Lawrenceville soils. Also included are some areas of fill of various sorts that are not presently built up.

Most areas of these soils are urban and are being further developed.

The seasonal high water table and slow permeability limit most nonfarm uses. Onsite investigation, however, is needed in open areas to determine the hazards and degree of limitation for specified uses. Capability unit unassigned.

Urban land-Chester complex, 0 to 8 percent slopes (UdB).—This complex is about 60 percent Urban land, 35 percent Chester soil, and 5 percent included soils. It is in semi-built-up areas, mainly in the gneiss and schist ridge and valley areas of Bucks and Philadelphia Counties. Areas are irregular in shape and 5 to 2,500 acres or more in size.

Included with this complex in mapping are some areas of Manor and Urbana soils. Also included are

some areas of fill of various sorts and a few areas where slopes are more than 8 percent.

Most areas of this complex are urban but are being further developed.

Drainage is good and slopes are nearly level to gentle; therefore this complex is only slightly limited for most nonfarm uses. Onsite investigation is needed, however, in open areas to determine the hazards and degree of limitation for specified uses. Capability unit unassigned.

Urban land-Chester complex, 8 to 15 percent slopes (UdC).—This complex is about 60 percent Urban land, 35 percent Chester soils, and 5 percent included soils. It is in semi-built-up areas, mainly in the gneiss and schist ridges and valleys of Bucks and Philadelphia Counties. Areas are irregular in shape and 5 to 500 acres in size. Included in mapping are some areas of Manor soils and a few areas where slopes are more than 15 percent.

Most areas are urban and are being further developed.

Slope limits most nonfarm uses. Onsite investigation, however, is needed in open areas to determine the hazards and degree of limitation for specified uses. Capability unit unassigned.

Urban land-Howell complex (0 to 15 percent slopes) (Uh).—This complex is 60 percent Urban land, 35 percent Howell silt loam, and 5 percent included soils. It is in semi-built-up areas on terraces of the Coastal Plain. Areas are irregular in shape and 5 to 3,000 acres or more in size.

Included with this complex in mapping are some areas of Pope, Duncannon, Alton, Doylestown, Lawrenceville, and Woodstown soils. Also included are some areas of fill of various sorts that are not presently built up.

Most areas are urban and are being further developed.

Slow permeability limits nonfarm uses of this complex. Onsite investigation, however, is needed in open areas to determine the hazards and degree of limitation for specified uses. Capability unit unassigned.

Urban land-Lansdale complex, 0 to 8 percent slopes (UlB).—This complex is about 60 percent Urban land, 35 percent Lansdale soils, and 5 percent included soils. It is in semi-built-up areas that are mainly underlain by sandstone bedrock. Areas are irregular in shape and 5 to 700 acres in size.

Included with this complex in mapping are some areas of Duncannon, Lawrenceville, Readington, Abbottstown, Steinsburg, and Doylestown soils. Also included are some areas of fill of various sorts that are not presently built up.

Most areas are urban and are being further developed.

This complex has good drainage and is nearly level to gently sloping; therefore it is only slightly limited for most nonfarm uses. Onsite investigation is needed, however, in the open areas to determine the hazards and degree of limitation for specified uses. Capability unit unassigned.

Urban land-Lansdale complex, 8 to 15 percent slopes (UlC).—This complex is about 60 percent Urban land, 35 percent Lansdale soils, and 5 percent included soils. It is in semi-built-up areas that are mainly underlain by sandstone bedrock. Areas are irregular in shape and 5 to 200 acres in size.

The profile of the Lansdale soil is similar to the one described as representative of the Lansdale series, but the subsoil is slightly thinner and the content of coarse fragments is slightly greater.

Included with this complex in mapping are some areas of Readington and Steinsburg soils. Also included are a few areas where slopes are more than 15 percent.

Most areas are urban and are being further developed.

Slope limits most nonfarm uses of this complex. Onsite investigation, however, is needed in open areas to determine the hazards and degree of limitation for specified uses. Capability unit unassigned.

Urbana Series

The Urbana series consists of deep, moderately well drained to somewhat poorly drained, nearly level to gently sloping soils on uplands. These soils are at the base of slopes and in depressional areas. They formed in loamy material weathered chiefly from gneiss and schist.

In a representative profile in a cultivated area, the plow layer is dark-brown silt loam about 10 inches thick. The subsoil is 29 inches thick. The upper 8 inches is strong-brown silty clay loam. The lower 21 inches is a reddish-yellow silty clay loam fragipan that has gray mottles. It is compact, firm and brittle, and it has prismatic and platy structure. The substratum is a gray very gravelly clay loam fragipan that extends to a depth of 50 inches. It is firm and brittle and contains many strong-brown mottles.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. Available water capacity is moderate, and permeability is slow. The water table rises to within 12 to 24 inches of the surface during wet seasons. Restricted permeability and wetness are limitations to most nonfarm uses of these soils.

Representative profile of Urbana silt loam, 3 to 8 percent slopes, in a hayfield 600 feet south of Lehnenburg Road, in Durham Township:

Ap—0 to 10 inches, dark-brown (10YR 4/3) silt loam; moderate, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

B2t—10 to 18 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, coarse, subangular blocky structure; friable, sticky and plastic; thick clay films on peds; less than 2 percent coarse fragments; slightly acid; clear, wavy boundary.

Bx—18 to 39 inches, reddish-brown (7.5YR 6/6) silty clay loam; gray (5Y 6/1) ped faces; many, coarse, prominent, gray (5Y 6/1) mottles; moderate, very coarse, prismatic structure parting to very thick, platy; firm and brittle, sticky and plastic; thick silt and clay films on faces of peds; 5 percent quartz and gneiss fragments; slightly acid; gradual, wavy boundary.

Cxg—39 to 50 inches, gray (5Y 6/1) very gravelly clay loam; many, coarse, prominent, strong-brown (7.5YR 5/6) mottles; weak, thick, platy structure; firm and brittle, sticky and plastic; few clay films; 65 percent gravel; slightly acid.

The solum ranges from 30 to 40 inches in thickness. Depth to the fragipan ranges from 16 to 24 inches. Depth to bedrock is 4 to 6 feet. The content of coarse fragments of schist, gneiss, or quartzite generally increases with increasing depth from less than 3 to 25 percent in the solum and from 25 to 65 percent in the C horizon. Mica is abundant in profiles formed in material weathered from schist. The B horizon ranges from yellowish brown to reddish yellow. It is silty clay loam, clay loam, and heavy silt loam.

Urbana soils in Bucks and Philadelphia Counties contain fewer schistose fragments than is defined in the range for the series, but this difference does not alter the use, management, or behavior of these soils.

Urbana soils are in close association with well-drained Chester and Manor soils and formed in similar material, but Urbana soils have a fragipan and Chester and Manor soils do not. Urbana soils have a thicker solum than Manor soils.

Urbana silt loam, 0 to 3 percent slopes (UrA).—This soil is in concave positions at the base of slopes and in depressions. Areas are generally irregular in shape and 3 to 25 acres in size.

Included with this soil in mapping are some areas of similar soils that are poorly drained. These areas are indicated on the detailed soil map by a special symbol if they are significant in size.

Most of this soil is used for crops. It is suited to moisture-tolerant field crops, grasses, and legumes. Most deep-rooted crops are subject to damage by frost heaving.

The seasonal high water table and slow permeability limit most nonfarm uses of this soil. Capability unit IIw-2.

Urbana silt loam, 3 to 8 percent slopes (UrB).—This soil is at the bases of slopes. Areas are generally irregular in shape and 3 to 15 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some small areas of similar soils that are poorly drained. Also included are a few areas of more sloping Urbana silt loam.

Most of this soil is used for crops and pasture. It is suited to moisture-tolerant field crops, grasses, and legumes. Most deep-rooted crops are subject to damage by frost heaving.

The seasonal high water table and slow permeability limit most nonfarm uses of this soil. Capability unit IIe-5.

Washington Series

The Washington series consists of deep, well-drained, gently sloping to sloping soils on uplands. These soils are on side slopes and hilltops. They formed in loamy material weathered chiefly from limestone.

In a representative profile in a cultivated area, the plow layer is dark-brown gravelly silt loam about 8 inches thick. The subsoil is 48 inches thick. The upper 14 inches is strong-brown silt loam. The next 26 inches is strong-brown and reddish-yellow gravelly silty clay loam and gravelly clay loam. The lower 8 inches is brown gravelly clay loam.

Runoff is medium, and the hazard of erosion is moderate to high. Available water capacity is high, and permeability is moderate. The slope, the hazard of erosion, and the hazard of ground water contamination through underground solution channels are limitations to most nonfarm uses of these soils.

Representative profile of Washington gravelly silt loam, 3 to 8 percent slopes, in a cultivated field 1 mile west of Riegelsville:

Ap—0 to 8 inches, dark-brown (10YR 3/3) gravelly silt loam; weak, thin, platy structure; friable; 15 percent quartzite gravel; slightly acid; abrupt, smooth boundary.

B1—8 to 12 inches, strong-brown (7.5YR 5/6) silt loam; dark-brown (10YR 3/3) material in root channels; weak, thin, platy structure; friable; 5 percent quartzite gravel; neutral; clear, smooth boundary.

B21t—12 to 22 inches, strong-brown (7.5YR 5/6) heavy silt loam; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; thick clay films in old root channels and wormholes; 10 percent quartzite gravel; slightly acid; clear, wavy boundary.

B22t—22 to 32 inches, strong-brown (7.5YR 5/6) gravelly silty clay loam; moderate, medium, subangular blocky structure; friable, sticky and plastic; nearly continuous clay films on peds; 20 percent quartzite and gneiss gravel; many black coatings; medium acid; clear, wavy boundary.

B23t—32 to 48 inches, reddish-brown (7.5YR 6/8) gravelly clay loam; moderate, medium, subangular blocky structure; firm, sticky and plastic; thick, nearly continuous clay films on peds; 20 percent quartzite and gneiss gravel; many black coatings; medium acid; clear, wavy boundary.

B3—48 to 56 inches, brown (7.5YR 5/4) gravelly clay loam; weak, thick, platy structure; firm, sticky and plastic; 25 percent gneiss and quartzite gravel; medium acid.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock ranges from 5 to 10 feet. The content of coarse fragments ranges from 5 to 25 percent in the A and B2 horizons and from 15 to 35 percent in the B3 and C horizons. The B2 horizon ranges from strong brown to reddish yellow and from heavy silt loam to clay loam.

The well drained Washington soils are in close association with moderately well drained Clarksburg soils. Washington soils are in the same area as Chester soils but have higher base saturation than Chester soils.

Washington gravelly silt loam, 3 to 8 percent slopes (WaB).—This soil is in valleys in the uplands between nearly level alluvial soils and extremely stony soils on high ridges. Areas are irregular in shape and 3 to 100 acres in size.

Included with this soil in mapping are small areas of eroded Washington soils. Also included are some areas of soils that contain more sand and fewer coarse fragments. These soils are west of Riegelsville.

Most of this soil is used for crops. It is suited to most cultivated crops commonly grown in the area.

This soil has good drainage and gentle slopes; therefore it is only slightly limited for most nonfarm uses. Capability unit IIe-2.

Weikert Series

The Weikert series consists of shallow, well-drained, gently sloping to moderately steep soils on uplands. These soils are on side slopes and ridgetops. They formed in loamy material weathered chiefly from gray and yellow shale.

In a representative profile in a cultivated area, the plow layer is dark-brown shaly silt loam about 8 inches thick. The subsoil is yellowish-brown very shaly silt loam 7 inches thick. The substratum extends to a depth of 18 inches. It is yellowish-brown very silty loam underlain by dark-gray, fractured argillite shale bedrock.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Available water capacity is very low, and permeability is moderately rapid. The depth to bedrock and slope are limitations to most nonfarm uses of these soils.

Representative profile of Weikert shaly silt loam, in an area of Culleoka-Weikert shaly silt loams, 8 to 15 percent slopes, in a hayfield 100 feet southwest of Sellersville Road, 2½ miles northwest of Chalfont:

Ap—0 to 8 inches, dark-brown (10YR 3/3) shaly silt loam; weak, very fine, granular structure; friable; 45 percent shale fragments; slightly acid; abrupt, smooth boundary.

B2—8 to 15 inches, yellowish-brown (10YR 5/4) very shaly silt loam; weak, very fine, subangular blocky structure; friable, slightly sticky; 60 percent shale fragments; slightly acid; gradual, wavy boundary.

C—15 to 18 inches, yellowish-brown (10YR 5/4) very shaly silt loam; massive; friable; 80 percent shale fragments; slightly acid; gradual, wavy boundary.

R—18 inches +, dark-gray (10YR 4/1), fractured argillite shale bedrock.

The solum ranges from 12 to 20 inches in thickness. Depth to bedrock ranges from 14 to 20 inches. The content of coarse fragments of shale and siltstone ranges from 30 to 50 percent in the Ap horizon, from 45 to 65 percent in the B horizon, and from 60 to 85 percent in the C horizon. The B and C horizons are yellowish brown and brown. The C horizon is strongly acid to slightly acid.

Weikert soils in Bucks and Philadelphia Counties have a higher reaction than is defined in the range for the series. This difference, however, does not alter the use, management, or behavior of these soils.

Weikert soils are in close association with deep Bedington soils and moderately deep Culleoka soils. All these soils formed in similar material. Weikert soils are in the same area as Readington and Abbottstown soils that have a fragipan and mottles in the subsoil. Those soils formed in material weathered chiefly from red shale.

Weikert-Culleoka shaly silt loams, 15 to 25 percent slopes (WcD).—This complex is about 60 percent Weikert soils, 35 percent Culleoka soils, and 5 percent included soils. These soils are on hillsides and ridges. Areas are elongated and 4 to 50 acres in size. The profiles of these soils are similar to those described as representative of their respective series, but they are a few inches shallower over bedrock and contain more shale fragments.

Included with these soils in mapping are some small areas of Weikert and Culleoka soils that have a stony surface layer and some areas of eroded Weikert and Culleoka soils that are missing almost all of the original surface layer.

These soils are mainly used for crops or pasture. Droughtiness and slope are limitations for cultivated crops.

The depth to bedrock and slope limit most nonfarm uses of these soils. Capability unit VIe-1.

Woodstown Series

The Woodstown series consists of deep, moderately well drained, nearly level soils on terraces on the Coastal Plain. These soils are in concave positions along drainageways and at the base of slopes. They formed in loamy, old Coastal Plain sediment. They have a thin, silty surface mantle.

In a representative profile in a cultivated area, the plow layer is dark-brown silt loam about 9 inches thick. The subsoil is 23 inches thick. The upper 9 inches is mottled, yellowish-brown silt loam. The lower 14 inches is yellowish-brown gravelly sandy clay loam and sandy clay loam that has light-gray and reddish-yellow mottles. The substratum is brownish-yellow sandy clay loam that extends to a depth of 50 inches.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is high, and permeability is moderate. The water table commonly rises to within 18 to 36 inches of the surface during wet seasons. Wetness is a limitation to most nonfarm uses of these soils.

Representative profile of Woodstown silt loam, 0 to 5 percent slopes, in a pasture 3 miles southeast of Morrisville:

Ap—0 to 9 inches, dark-brown (10YR 3/3) silt loam; moderate, fine, granular structure; friable; few scattered quartz pebbles; slightly acid; abrupt, smooth boundary.

B21t—9 to 18 inches, yellowish-brown (10YR 5/6) silt loam; common, fine, distinct, light-gray (10YR 7/2) and reddish-yellow (5YR 6/8) mottles; weak, very coarse, prismatic structure parting to moderate, very thick, platy; friable; thin, discontinuous clay films on prism and plate faces; strongly acid; clear, wavy boundary.

IIB22t—18 to 23 inches, yellowish-brown (10YR 5/4) gravelly sandy clay loam; light-gray (5Y 7/1) ped faces; interiors have common, fine, distinct, light-gray (5Y 7/1) and reddish-yellow (7.5YR 7/8) mottles; moderate, coarse, subangular blocky structure; very firm, sticky and plastic; thick clay films on faces of peds; 20 percent quartzite fragments; strongly acid; clear, wavy boundary.

IIB23t—23 to 32 inches, yellowish-brown (10YR 5/6) sandy clay loam; light-gray (5Y 7/1) plate faces; interiors have common, fine, distinct, light-gray (5Y 7/1) and reddish-yellow (7.5YR 7/8) mottles; moderate, very thick, platy structure parting to medium, subangular blocky; very firm, sticky and plastic; thick clay films on faces of peds; 3 percent gravel fragments; strongly acid; clear, wavy boundary.

IIC—32 to 50 inches, brownish-yellow (10YR 6/6) sandy clay loam; massive; firm, plastic; strongly acid.

The solum ranges from 27 to 40 inches in thickness. Depth to bedrock ranges from 4 to 12 feet. The B horizon ranges from yellowish brown to light olive brown and is sandy clay loam or loam. It is strongly acid to extremely acid, and the content of coarse fragments ranges from 0 to 35 percent of the soil mass.

Woodstown soils in Bucks and Philadelphia Counties have a silty mantle 10 to 20 inches thick and have more coarse fragments in the lower part of the solum than is defined in the range for the series. These differences, however, do not alter the use, management, or behavior of these soils.

Woodstown soils are in close association with the well-drained Howell and poorly drained Fallsington soils. All these soils formed in similar material. Woodstown soils in the same area as Lawrenceville and Doylestown soils, but those soils are more silty than Woodstown soils.

Woodstown silt loam, 0 to 5 percent slopes (WoA).—This soil is at the base of slopes and in depressional areas. Areas are elongated or irregular in shape and 3 to 25 acres in size.

Included with this soil in mapping are some areas of similar soils that are more silty throughout and a few small areas of Howell and Fallsington soils.

Most of this soil is used for crops or is idle. It is suited to most cultivated crops commonly grown in the area. Deep-rooted plantings, however, are subject to damage by frost heaving.

The seasonal high water table limits most nonfarm uses. Capability unit IIw-2.

Formation, Morphology, and Classification of the Soils

The first part of this section tells how the soils of Bucks and Philadelphia Counties formed and describes the factors that influence soil formation. The second part deals with the morphology and structural makeup of the soils. The third part classifies the soils according to the current system of soil classification.

Formation of the Soils

Soil formation begins with the physical weathering of rock. In the weathering process large pieces of rock are broken into smaller pieces by frost wedging, differential expansion, unloading, colloidal plucking, hydration, and other natural forces. Eventually the rock and its fragments are reduced in size to particles of sand, silt, and clay. This unconsolidated soil material is in a layer in which plants take root and grow. As the plants mature and die, they form a mat on the surface, as can be seen on the Chester, Neshaminy, and other forested soils. The upper part of the mat consists of relatively fresh leaves and twigs, and the lower part, directly above the mineral soil, is well-rooted humus. From this mat, organic matter is added to the mineral soil.

The transfer of material from one part of the soil to another is common in most soils. Organic matter is suspended in solution and moved. Calcium and other elements are leached from the surface layer. To some extent, these elements are held by the clay in the subsoil or lower part of the profile, but part is leached out of the soil by ground water. Bases are absorbed by plant roots and stored in the stems, leaves, and twigs of plants. When plants die and decay, they return to the soil the elements they took from it.

Soils are complex mixtures of weathered rock, primary and secondary minerals, organic matter, water, and air. These components are present in varying quantities. The characteristics, or properties, of all soils depend on plants and animals and climate, acting on the earthy parent material, as conditioned by relief and the age of the landform. The importance of each soil-forming factor differs from place to place. Normally, however, the interaction of all the factors determine the kind of soil that forms in any given place.

Plant and animal life

Living organisms important to soil formation include plants, animals, bacteria, and fungi. The plants are largely responsible for the amount of organic matter, the color, and the accumulation of nutrients in the surface layer. Earthworms, cicada, and other burrowing animals help keep the soil open and porous. Bacteria and fungi decompose the vegetation, thus recycling nutrients for plant food. In Bucks and Philadelphia Counties the native forests have had a profound influence on soil formation. Man, however, has greatly affected the soil surface where he has cleared the forests and plowed the land. He has added fertilizers, mixed some of the soil horizons, and has even moved soil material from place to place. Continuous farming for more than 200 years has caused accelerated erosion on some soils.

Climate

The climate of Bucks and Philadelphia Counties is modified humid continental. It affects the formation of soils through its influence on the rate that rock weathers and minerals and organic matter decompose. The climate is fairly uniform throughout the area except for the slightly higher average temperature in the southern part. For more detailed information on climate, see the section "Environmental Factors Affecting Soil Use."

Parent materials

Parent material is the unconsolidated earthy substance from which the soils formed. It determines the initial mineral and chemical composition of the soil and influences the rate and balance of soil-forming processes that take place. In Bucks and Philadelphia Counties the soils formed in materials weathered in place from many kinds of rocks or in transported materials as seen in table 10. The transported materials were moved by water, wind, or glacial action and then deposited in varying proportions in unconsolidated layers of silt, clay, sand, and gravel.

Most of the soils in the area formed in place and are called residual soils. Many differences among such soils are related directly to variations among the parent rocks. The Abbottstown, Lansdale, and Readington soils formed in material weathered from red and gray sandstone and shale. Towhee, Neshaminy, and Mount Lucas soils formed in weathered diabase, an intrusive, igneous rock. In Philadelphia County and the southern part of Bucks County, the Chester, Manor, and Urbana soils formed in weathered gneiss and schist rocks. Duncannon, Lawrenceville, and Chalfont soils formed in silty, windblown materials that are underlain by a wide range of highly contrasting soil and rock materials. Allenwood and Washington soils formed in glacial and glacially influenced material. Alton, Pope, and Bowmansville soils, which formed in recent outwash and alluvium, have little horizonation. Soils formed in old alluvium of the Coastal Plain terraces, such as the Howell and Woodstown soils, have more strongly developed horizons.

Relief

Relief, through its influence on natural drainage, is a modifying factor in the formation of soils and the rate of erosion. The extensive areas of low relief in Bucks and Philadelphia Counties have contributed to seasonal water tables in Abbottstown, Readington, Lawrenceville, Chalfont, Urbana, and other soils. Soils in areas of greater relief and generally steeper slopes, where the surface water rapidly drains away, are generally well drained. The Chester, Penn, and Lansdale soils are examples of well-drained soils.

Time

The effectiveness of climate, relief, and living organisms in changing parent material into soil is governed by the time these factors have been active. The degree of profile formation generally indicates the relative age

TABLE 10.—*Parent materials and drainage relationships of soil series*

[Dashes indicate that no soil series is used in this position]

Position on the landscape and parent material	Drainage class			
	Well drained	Moderately well drained	Somewhat poorly drained	Poorly drained
UPLAND:				
Deep soils formed in loamy glacial till or frost-churned material derived from red and gray shale and sandstone.	Allenwood	----------	----------	----------
Deep soils formed in loamy material weathered mostly from limestone.	Duffield; Washington.	Clarksburg	----------	----------
Deep soils formed in loamy material weathered mostly from gneiss and schist.	Chester; Manor	Urbana	Urbana	----------
Deep soils formed in loamy material weathered mostly from diabase.	Neshaminy	Mount Lucas	Mount Lucas	Towhee.
Deep soils formed mostly in silty, wind-deposited sediment.	Duncannon	Lawrenceville	Chalfont	Doylestown.
Deep soils formed in loamy material weathered mostly from red and brown shale and sandstone.	Bedington; Lansdale.	Readington	Abbottstown	----------
Deep soils formed in loamy material weathered mostly from gray metamorphosed shale and sandstone.	----------	Lehigh	Lehigh	----------
Moderately deep soils formed in loamy material weathered mostly from red shale.	Penn	Reaville	Reaville	----------
Moderately deep soils formed in loamy material weathered mostly from yellow and gray shale.	Culleoka	----------	----------	----------
Moderately deep soils formed in loamy material weathered from sandstone and conglomerate.	Steinsburg	----------	----------	----------
Shallow soils formed in loamy material weathered mostly from red shale and sandstone.	Klinesville	----------	----------	----------
Shallow soils formed in loamy material weathered mostly from gray and yellow shale.	Weikert	----------	----------	----------
TERRACE:				
Deep soils formed in loamy and clayey material of mixed old Coastal Plain sediment.	Howell	Woodstown	----------	Fallsington, gravelly subsoil variant.
Deep soils formed mostly in recent outwash material.	Alton; Pope, terrace.	----------	----------	----------
FLOOD PLAIN:				
Deep soils formed mostly in loamy alluvium derived from mixed shale, sandstone, quartz, and limestone.	Pope; Alton, flooded.	----------	----------	----------
Deep soils formed in loamy alluvium washed from upland soils underlain by shale and sandstone.	----------	Rowland	Rowland	Bowmansville.
Deep soils formed in loamy alluvium washed from upland soils underlain by gneiss, schist, and diabase.	----------	----------	----------	Hatboro.

of the soil. Bowmansville, Rowland, and Hatboro soils are on flood plains and are younger than most other soils of the area. Organic matter has accumulated on the surface, but the subsoil horizons are less distinct than those in the older soils of the Coastal Plain terraces and uplands. Howell, Penn, Abbottstown, and Chester soils have well-formed profiles. These soils of the Coastal Plain terraces and uplands have been in place long enough for distinct horizon formation.

Morphology

Morphology is concerned with the form and structure of soils. The morphology of a soil is the result of the interaction of all factors of soil formation at a particular place.

The soil profile extends from the surface downward to materials that are little altered by the soil-forming processes. Most soils contain three major horizons called A, B, and C (*15*). These major horizons may be further subdivided by the use of numbers and letters to indicate changes within one horizon. An example would be B2t, which represents a layer within the B horizon that contains translocated clay from the A horizon.

The A horizon is the surface layer. It may be subdivided into an A1 horizon that has the largest accumulation of organic matter and an A2 horizon that has maximum leaching, or eluviation, of clay and iron. The A2 horizon of most soils in this survey area shows brownish colors resulting from oxidation of iron.

The B horizon lies underneath the A horizon and is commonly called the subsoil. In most soils of the area

it is the horizon of maximum accumulation, or illuviation, of clay, iron, aluminum, or other compounds leached from the A horizon. In some soils the B horizon is a product of alteration of the parent material in place. This may be caused by oxidation and reduction of iron or by mineral weathering. The B horizon generally has blocky, platy, or prismatic structure and is usually more firm and lighter colored than the A1 horizon.

The C horizon underlies the A or B horizon. It consists of material that may have been modified by weathering but that is relatively unaffected by the biological, physical, and chemical changes involved in A and B horizon formation.

There are several processes involved in the formation of soil profiles in Bucks and Philadelphia Counties. These include the accumulation of organic matter; the leaching of soluble salts; the reduction and translocation of iron; the formation of soil structure; and some translocation and loss of clay minerals, aluminum, silica, and iron. These processes proceed at different rates, depending on soil properties and environment.

In the humid climate of this area, carbonate minerals that may have been in the parent material are decomposed by water that has been made slightly acid with dissolved carbon dioxide and organic acids. The calcium and magnesium dissolved from carbonates and other soluble salts formed during weathering of primary minerals are largely leached from the soil and pass into the drainage waters.

During storms of high intensity, water percolates through the soil and washes suspended clay particles from the upper to the lower horizons. As the clay particles accumulate, they form characteristic films of oriented clay on the surfaces of cracks and openings. These are referred to as clay films. This process increases the clay content of the B horizon as much as 12 to 25 percent, as indicated by the clay data for the Chalfont and Doylestown profiles. These clay-enriched subsurface horizons are diagnostic for classification of the soil.

The oxidation and reduction of iron depend mainly on the height of the water table in the soil. The brown or strong-brown B horizon of well-drained soils, such as those of the Chester and Bedington series, indicates the presence of oxidized iron compounds and the lack of a water table. Brownish or reddish soils mottled with gray indicate some reduction of iron resulting from a fluctuating water table. Poorly drained soils, such as those of the Towhee series, have a grayish B horizon indicative of iron reduction caused by a more permanent water table.

Many moderately well drained and poorly drained soils have developed a subsurface horizon that is firm or very firm and brittle when moist. This horizon has a closely packed soil matrix, high bulk density, and, in many places, large polyhedrons separated by gray material. The process by which this horizon is formed is not completely understood, but clay bridges or silica and aluminum oxides are thought to be involved as bonding agents between soil particles. Horizons with these characteristics are called fragipans. Readington, Abbottstown, and Doylestown soils have a fragipan.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

The current system of classifying soils described in this section was developed in the early sixties (*15*) and was adopted by the National Cooperative Soil Survey in 1965 (*18*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 11 shows the classification of each soil series of Bucks and Philadelphia Counties by family, subgroup, and order, according to the current system.

ORDER.—Ten soil orders are recognized in the classification system. These are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. The exceptions to this are the Entisols, Histosols, and, to some extent, Inceptisols, which occur in many different climates.

As shown in table 11, four soil orders are represented in Bucks and Philadelphia Counties: Entisols, Inceptisols, Alfisols, and Ultisols.

Entisols are the youngest soils in Bucks and Philadelphia Counties. They show little evidence of soil horizon development other than darkening of the A horizon. Bowmansville and Hatboro soils are in this order.

Typical Inceptisols have a surface layer that has been darkened to a depth of several inches by organic matter. The B horizon has uniform color, weak or moderate structure, and little if any accumulation of silicate clay. The soils of this order range from somewhat poorly drained to well drained. Examples of Inceptisols in Bucks and Philadelphia Counties are the Pope, Rowland. Klinesville, and Manor soils.

Alfisols and Ultisols also have a surface layer that is darkened to a depth of several inches by organic matter. The B horizon has measurably more clay than the A horizon and has moderate or strong structure; in places, it has a fragipan. Base saturation in the Alfisols is higher than in Ultisols. The soils in these orders range from poorly drained to well drained. Doylestown, Abbottstown, and Penn soils are examples of Alfisols. Lansdale and Chester soils are examples of Ultisols.

TABLE 11.—*Classification of the soils*

Series	Family	Subgroup	Order
Abbottstown [1]	Fine-loamy, mixed, mesic	Aeric Fragiaqualfs	Alfisols.
Allenwood	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Alton [1]	Loamy-skeletal, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Bedington	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Bowmansville	Fine-loamy, mixed, nonacid, mesic	Aeric Fluvaquents	Entisols.
Chalfont	Fine-silty, mixed, mesic	Aquic Fragiudalfs	Alfisols.
Chester	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Clarksburg	Fine-loamy, mixed, mesic	Typic Fragiudalfs	Alfisols.
Culleoka	Fine-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols.
Doylestown [1]	Fine-silty, mixed, mesic	Typic Fragiaqualfs	Alfisols.
Duffield	Fine-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols.
Duncannon	Coarse-silty, mixed, mesic	Ultic Hapludalfs	Alfisols.
Fallsington,[1] gravelly subsoil variant.	Loamy-skeletal, siliceous, mesic	Aeric Ochraquults	Ultisols.
Hatboro	Fine-loamy, mixed, nonacid, mesic	Typic Fluvaquents	Entisols.
Howell	Clayey, mixed, mesic	Typic Hapludults	Ultisols.
Klinesville	Loamy-skeletal, mixed, mesic	Lithic Dystrochrepts	Inceptisols.
Lansdale	Coarse-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Lawrenceville	Fine-silty, mixed, mesic	Typic Fragiudalfs	Alfisols.
Lehigh	Fine-loamy, mixed, mesic	Aquic Hapludalfs	Alfisols.
Manor	Coarse-loamy, micaceous, mesic	Typic Dystrochrepts	Inceptisols.
Mount Lucas	Fine-loamy, mixed, mesic	Aquic Hapludalfs	Alfisols.
Neshaminy	Fine-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols.
Penn	Fine-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols.
Pope [1]	Coarse-loamy, mixed, mesic	Fluventic Dystrochrepts	Inceptisols.
Readington	Fine-loamy, mixed, mesic	Typic Fragiudalfs	Alfisols.
Reaville [1]	Fine-loamy, mixed, mesic	Aquic Hapludalfs	Alfisols.
Rowland	Fine-loamy, mixed, mesic	Fluvaquentic Dystrochrepts	Inceptisols.
Steinsburg	Coarse-loamy, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Towhee	Fine-loamy, mixed, mesic	Typic Fragiaqualfs	Alfisols.
Urbana [1]	Fine-loamy, mixed, mesic	Aquic Fragiudalfs	Alfisols.
Washington	Fine-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols.
Weikert [1]	Loamy-skeletal, mixed, mesic	Lithic Dystrochrepts	Inceptisols.
Woodstown [1]	Fine-loamy, siliceous, mesic	Aquic Hapludults	Ultisols.

[1] Taxadjuncts, or soils that do not fit in a series recognized in the classification system. They are named taxadjuncts to the series from which they differ in ways too small to be of consequence in interpreting their usefulness or behavior. Soils so named in Bucks and Philadelphia Counties are outside the range of the series in the following ways:
Abbottstown soils lack a gleyed horizon between depths of 12 and 20 inches.
Alton soils are thinner in the solum than is defined for the series.
Doylestown soils have slightly more clay than is defined for the series.
Fallsington gravelly subsoil variant has a much higher percentage of gravel in the subsoil than is defined for the Fallsington series.
Manor and Weikert soils have a higher reaction than is defined for the series.
Pope soils have a higher reaction and contain slightly more coarse fragments in the C horizon than are defined for the series.
Reaville soils have a weighted average of 35 to 60 percent shale fragments, which is higher than is defined for the series.
Urbana soils have fewer schistose coarse fragments than is defined for the series.
Woodstown soils have a silt mantle that is 10 to 20 inches thick and contain more coarse fragments in the lower part of the solum than is defined for the series.

SUBORDER.—Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUP.—Soil suborders are divided into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that have fragipans that interfere with growth of roots or movement of water. Examples of the features used are the self-mulching properties of clays, soil temperature, and major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium).

SUBGROUP.—Great groups are divided into subgroups, one representing the central (typic) segment of the group and others, called intergrades, that have properties of the group and also have one or more properties of another group, suborder, or order. Subgroups may also be made in those instances where soil properties are outside the range of any other great group, suborder, or order.

FAMILY.—Families are established within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, clay composition, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES.—The series is a group of soils formed from a particular type of parent material, essentially uniform in diagnostic characteristics and in arrangement of horizons.

Laboratory Determinations [6]

The physical and chemical properties of selected soils in Bucks County are given in tables 12 and 13, respectively. The series sampled are the Bedington, Chalfont, Doylestown, Duncannon, Lawrenceville, Pope, and Towhee.

One site for sampling was selected for each series. The sites were located in areas that were most representative of the soil series in internal characteristics and in slope, degree of erosion, and land use. At each site a pit was dug through the soil solum and into the parent material. Descriptions were written and samples were collected from each described horizon. A profile description for each soil sampled is included in the section "Descriptions of the Soils."

Methods of Analysis

Bulk samples of about 3 to 4 liters were collected from each horizon described. Coarse fragments greater than half an inch in diameter were sieved and weighed in the field. Air-dry samples were sieved for coarse fragments half an inch to 2 millimeters in diameter and weighed in the laboratory. Coarse-fragment data are presented as a percentage, by weight, of the total bulk sample.

The particle-size distribution of the material that passed through a 2-millimeter sieve was determined by the pipette method (*8*) and presented as percent, by weight, of material less than 2 millimeters in diameter.

Triplicate natural clods weighing about 100 to 300 grams were taken from each horizon where possible and coated with saran resin (*5*). Percent of moisture (by weight) retained at one-third bar tension (*17*) was determined for the entire clods and calculated for the material less than 2 millimeters in diameter. Available water capacity was calculated, correcting for the content of coarse fragments in the bulk sample. In these calculations it is assumed that no moisture is held by coarse fragments.

Bulk density was determined from triplicate clods at one-third bar moisture content and again at oven dryness. Bulk density for material finer than 2 millimeters was calculated for the moist and dry clods. COLE (coefficient of linear extensibility) was calculated from natural-clod bulk density measurements (*6*).

Correction of the COLE data for coarse fragments may be accomplished with nomographs or the formula presented by Holmgren (*7*). The bulk density of the total sample represents the average density of the soil mass, taking into account all coarse fragments in the bulk sample. The total bulk density was then multiplied by percentage by weight of available water capacity, corrected for coarse fragments, to get available water capacity in inches of water per inch of soil.

The bulk density of the total sample is also used in calculating percentage by volume of coarse fragments. If clods were not obtained, values of 1.60 and 2.65 were assigned as bulk density of the material finer than 2 millimeters and coarser than 2 millimeters respectively.

Soil reaction (pH) was determined electrometrically (glass electrode and pH meter) on air-dried samples, using a 1:1 soil: solution ratio. Cations were extracted with neutral, normal ammonium acetate solution (*12*). Calcium and magnesium were determined by atomic absorption spectrophotometry (*13*) and sodium and potassium by flame emission spectrophotometry. Barium chloride-triethanolamine, pH 8.1, was leached through a soil sample and the extract was titrated with 0.05 hydrochloric acid to determine extractable acidity (*10*). Organic carbon was determined by ignition in a Fisher carbon induction apparatus (*21*). Nitrogen was determined by the Kjeldahl method (*3*).

Clay minerals in selected horizons were identified by X-ray diffraction using copper radiation, Geiger counter, and chart recorder. Prior to X-ray analysis, the air-dry samples were treated with hydrogen peroxide to destroy organic matter. Iron oxides were removed by sodium dithionite-citrate-bicarbonate (*11*) and extracted iron determined colorimetrically with orthophenanthroline. Clay was separated with a centrifuge, one part saturated with potassium ions and one part saturated with magnesium ions. Suspensions of clay were placed on glass slides, allowed to air-dry and X-rayed to obtain diffraction traces. The magnesium-saturated slide was solvated with ethylene glycol and the potassium-saturated slide heated to 300° C and 550° C successively. Diffraction traces were obtained from each treatment. The traces were interpreted on the bases of peak height and relationship to known clay mixtures. Estimates were made to the nearest 5 or 10 percent.

Laboratory Interpretations

Particle-size distribution.—Duncannon, Lawrenceville, Chalfont, and Doylestown soils formed mainly in silty windblown materials underlain by Triassic sandstone and shale. The windblown materials are well sorted and are high in content of silt and relatively low in sand and clay. Doylestown soils contain somewhat more clay and less sand than the other soils that formed in the silty material. In some areas of Doylestown soils, the finer materials move from the soils on higher slope positions and are deposited in poorly drained lower areas. Duncannon, Lawrenceville, and Chalfont soils are similar in their distribution of sand, silt, and clay. The content of silt decreases and the content of sand increases with depth due to the presence of the underlying coarser textured sandstone and shale.

Bedington soils, formed in Triassic shale and sandstone, contain less silt and more sand than the soils formed in windblown material. Sand content increases with depth, which may be due to decreased weathering or to influences from silty windblown material.

Towhee soils, formed in Triassic diabase, are coarser textured than Bedington soils. Diabase weathers to a soil that has more sand and less silt than Bedington soils. This is especially evident in the lower horizons. The high silt content of the upper horizons may be due to silty windblown material.

[6] Samples were collected and laboratory determinations and interpretations of data were made by R. P. MATELSKI, R. W. RANNEY, G. W. PETERSEN, R. L. CUNNINGHAM, and E. J. CIOLKOSZ and staff of The Pennsylvania State University Soil Characterization Laboratory.

The Pope soil formed in alluvial material. Deposition by running water caused stratification of the sediment, as indicated by the sharp changes in particle-size distribution with depth. Sand content increases and silt and clay content decreases with depth. The upper horizons are high in content of fine and very fine sand, and the lower two horizons have a higher content of coarse and medium sand.

Coarse fragment content.—The soils derived from windblown material are low in content of coarse fragments. However, the lower horizons that formed in material weathered from the underlying shale and sandstone show a marked increase in content of coarse fragments. Bedington and Towhee soils are fairly high in content of coarse fragments, and the content of fragments varies considerably from horizon to horizon. Pope soils have almost no coarse fragments in the upper horizons but show a marked increase in the IIC1 horizon, where over 50 percent, by volume, of the soil mass consists of coarse fragments. Large amounts of coarse fragments limit use of the soil, since the fragments act as a dilutant within the soil mass and less soil material is available to retain water and plant nutrients.

Bulk density and coefficient of linear extensibility (COLE).—Bulk density is an expression of the weight per unit volume of the undisturbed mass. All the soil profiles have very similar bulk densities. However, the bulk density increases in fragipan horizons, which are indicated by an "x." A fragipan is a dense, firm, relatively impermeable horizon. This horizon has less pore space than other subsoil horizons and lower bulk densities, and the downward percolation of water and root growth are greatly restricted.

COLE is used to calculate potential amount of shrinking or swelling a soil may undergo upon saturation or drying. The higher the average COLE values for a soil, the greater the susceptibility of the soil to shrinking and swelling. This swelling may cause damage to structures in contact with the soil. Chalfont, Doylestown, Pope, Lawrenceville, and Bedington soils have low COLE values and little shrink-swell hazard. Duncannon and Towhee soils have moderate COLE values and some shrink-swell hazard for small buildings if water content is changeable.

Available water capacity.—Measurement of the percentage of water retained at two different tensions permits the estimation of the water storage capacities of soils. The greater the difference between the ⅓- and 15-bar tension values, the higher the water storage capacity of the soil. Since coarse fragments generally hold little or no available water, corrections must be made in calculations when they are present. The available water capacity values given in the table are for the whole soil mass, including coarse fragments.

Values approaching 0.2 inch of water per inch of soil are high, and those below 0.1 inch per inch of soil are moderate to low. Pope soils are low to moderate in their ability to retain available water. Bedington soils are moderate to high, and Towhee soils are high in the upper two horizons and low to moderate in the lower horizons. Duncannon and Lawrenceville soils have high available water capacity, and Chalfont and Doylestown soils have moderate to high available water capacity. It should be noted that the available water figures are not applicable if the water table is within the root zone or if a fragipan is present, because plant roots are not able to penetrate.

Organic carbon and nitrogen.—Carbon and nitrogen are both components of organic matter. The amount of organic matter in a soil can be estimated by multiplying the organic carbon content by 2. Organic matter improves the structure and workability of the soil and increases its nutrient and water holding capacities. The content of organic matter is generally high near the surface and decreases sharply with depth.

Soil organic matter contains nitrogen that becomes avaliable to plants when released by microbial activity. For farming, a carbon to nitrogen ratio of about 10 is generally desired. The soils of the survey area have favorable carbon to nitrogen ratios.

Soil reaction.—Reaction (pH) is a measure of the relative acidity of the soil. The use of potassium chloride or calcium chloride solutions helps eliminate seasonal variability due to the influence of soluble salts in the soil. Most of the soils, with the possible exception of the Towhee soil, are acid. The pH generally increases with depth because the upper horizons leach more.

Cation exchange properties.—Soil mineral and organic particles adsorb positively charged ions (cations) such as calcium, magnesium, sodium, and potassium (generally called bases) as well as acidic cations such as aluminum and hydrogen. These cations are held in the soil and are not readily leached by water, but can be displaced by other cations in the soil solution. The capacity of soil material to hold cations depends on its content of clay and organic matter. The total of the extractable cations (basic and acidic) equals the cation exchange capacity of a given soil sample. Base saturation is the percentage of the cation exchange capacity satisfied by bases. High base saturation often indicates a fertile soil, because the bases are plant nutrients. Excess acidity generally is detrimental to plant growth.

Pope and Towhee soils represent the extremes in cation exchange properties. Pope soils are low in bases, cation exchange capacity, and base saturation, and Towhee soils are high in bases, cation exchange capacity, and base saturation. In general, the soils that formed in silty material increase in total bases, cation exchange capacity, and base saturation as they become more poorly drained. In all soils, calcium and magnesium are the most common cations.

Clay mineralogy.—The quantity and type of clay minerals in the profiles sampled in some cases show significant variation from soil to soil and within the soils. These variations are a function of the mineralogy of the parent material and of changes that have taken place during soil-forming processes.

Duncannon, Lawrenceville, Chalfont, and Doylestown soils form a drainage sequence of soils that formed mainly in silty wind-deposited sediment and underlying sedimentary rock. The clay mineralogy of the silty horizons of the Duncannon profile shows that illite, kaolinite, and vermiculite are dominant, and that montmorillonite, chlorite, and intergrade vermiculite-chlorite are secondary in abundance. The major variation in the upper horizons is a decreasing quantity of vermiculite

TABLE 12.—*Physical properties*

[Analysis by the Pennsylvania State University Soil Characterization Laboratory.

Soil and sample number	Horizon	Depth from surface	Size distribution of particles less than 2 mm in diameter						
			Very coarse sand (2.0 to 1.0 mm)	Coarse sand (1.0 to 0.5 mm)	Medium sand (0.5 to 0.25 mm)	Fine sand (0.25 to 0.10 mm)	Very fine sand (0.10 to 0.05 mm)	Silt (0.02 to 0.002 mm)	Silt (0.005 to 0.002 mm)
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Bedington silt loam:									
S68 Pa 09-9-1	Ap	0-13	2. 5	3. 1	2. 5	1. 7	3. 3	35. 7	11. 2
S68 Pa 09-9-2	B21t	13-25	. 2	. 7	1. 2	1. 8	2. 7	39. 4	10. 6
S68 Pa 09-9-3	B22t	25-38	. 7	3. 4	3. 6	2. 8	4. 2	38. 4	11. 7
S68 Pa 09-9-4	B23t	38-51	4. 3	9. 9	5. 7	3. 2	2. 7	44. 5	13. 0
S68 Pa 09-9-5	B24t	51-57	1. 2	6. 2	6. 4	4. 0	3. 9	51. 6	19. 0
S68 Pa 09-9-6	B3	57-70	. 9	5. 3	5. 6	4. 4	4. 4	53. 9	21. 6
	R	70	----------	----------	----------	----------	----------	----------	----------
Chalfont silt loam:									
S68 Pa 09-6-1	Ap	0-10	. 8	. 7	. 6	. 5	1. 6	42. 8	10. 1
S68 Pa 09-6-2	B21t	10-14	. 6	. 5	. 5	. 2	1. 8	40. 1	11. 1
S68 Pa 09-6-3	B22t	14-21	. 2	. 7	. 3	. 6	2. 0	40. 3	10. 3
S68 Pa 09-6-4	Bx1	21-27	. 2	. 5	. 6	. 5	1. 9	36. 1	6. 9
S68 Pa 09-6-5	Bx2g	27-33	. 5	. 4	. 7	. 4	1. 9	40. 2	8. 1
S68 Pa 09-6-6	IIBx3	33-47	3. 5	2. 9	2. 1	1. 1	2. 0	42. 5	14. 7
S68 Pa 09-6-7	IIBx4	47-57	4. 4	3. 2	1. 8	1. 5	1. 6	43. 7	17. 2
S68 Pa 09-6-8	IIC	57-70	4. 2	7. 4	5. 0	3. 6	2. 8	41. 1	11. 3
Doylestown silt loam:									
S68 Pa 09-8-1	Ap	0-11	1. 7	1. 9	1. 0	. 8	1. 7	42. 1	10. 9
S68 Pa 09-8-2	B2tg	11-20	----------	. 1	. 2	. 3	1. 6	33. 2	8. 0
S68 Pa 09-8-3	Bx1g	20-25	----------	. 8	1. 2	1. 4	2. 9	37. 9	9. 0
S68 Pa 09-8-4	Bx2g	25-32	. 1	. 8	1. 8	1. 9	3. 2	36. 5	8. 4
S68 Pa 09-8-5	Bx3g	32-38	. 1	. 4	. 5	. 7	2. 2	38. 7	8. 5
S68 Pa 09-8-6	Bx4g	38-45	----------	. 3	. 6	. 5	2. 5	40. 4	9. 2
S68 Pa 09-8-7	Bx5g	45-53	. 4	. 8	. 6	. 9	1. 7	40. 0	7. 5
	IIR	53	----------	----------	----------	----------	----------	----------	----------
Duncannon silt loam:									
S68 Pa 09-5-1	Ap	0-10	. 2	. 8	1. 6	2. 1	3. 9	37. 2	5. 5
S68 Pa 09-5-2	B1	10-17	----------	. 8	1. 2	1. 4	3. 2	38. 7	8. 3
S68 Pa 09-5-3	B21t	17-24	. 8	1. 0	1. 5	1. 5	3. 1	35. 3	6. 6
S68 Pa 09-5-4	B22t	24-34	1. 3	1. 9	2. 2	1. 3	3. 7	36. 8	6. 3
S68 Pa 09-5-5	B3	34-45	. 1	. 8	1. 2	1. 1	3. 3	40. 7	6. 4
S68 Pa 09-5-6	IIC1	45-49	2. 4	3. 3	3. 3	2. 2	4. 7	33. 8	7. 3
S68 Pa 09-5-7	IIC2	49-56	6. 4	5. 1	3. 0	2. 5	3. 6	31. 8	10. 5
S68 Pa 09-5-8	IIIC3	56-68	3. 9	5. 1	3. 4	2. 6	4. 5	31. 4	10. 4
Lawrenceville silt loam:									
S68 Pa 09-3-1	Ap	0-11	. 6	1. 7	2. 0	2. 1	5. 4	29. 9	4. 7
S68 Pa 09-3-2	B21t	11-19	. 3	1. 0	1. 5	1. 1	5. 4	29. 8	6. 7
S68 Pa 09-3-3	B22t	19-25	. 1	1. 0	1. 5	1. 2	4. 8	33. 8	9. 7
S68 Pa 09-3-4	Bx1	25-34	. 2	. 6	. 8	. 5	4. 1	34. 4	9. 5
S68 Pa 09-3-5	Bx2	34-40	. 5	1. 6	1. 9	1. 7	6. 3	26. 8	7. 3
S68 Pa 09-3-6	Bx3	40-47	. 1	. 9	1. 4	1. 0	6. 2	29. 2	6. 5
S68 Pa 09-3-7	C1	47-57	. 3	1. 4	1. 8	1. 9	5. 7	31. 4	5. 8
S68 Pa 09-3-8	C2	57-72	. 5	1. 6	3. 0	3. 1	4. 6	30. 1	4. 6
S68 Pa 09-3-9	IIC3	72-81	4. 5	14. 8	19. 3	12. 9	8. 9	12. 4	5. 0

of selected soils

Dashes in column indicate material not present or determination not made]

Size distribution of particles less than 2 mm in diameter—Continued			Coarse fragments more than 2 mm in diameter				Bulk density at field moisture content		Coefficient of linear extensibility	Material finer than 2 mm that has moisture held at tension of—		Available water of whole soil
Total sand (2.0 to 0.05 mm)	Total silt (0.05 to 0.002 mm)	Total clay (less than 0.002 mm)	Percent by weight: 76 to 79 mm	Percent by weight: 19 to 2.0 mm	Percent by weight: Total	Total percent by volume	Material finer than 2 mm	Whole soil including coarse fragments		One-third bar	15 bars	
Percent	*Percent*	*Percent*					*Grams per cubic centimeter*	*Grams per cubic centimeter*		*Percent*	*Percent*	*Inches per inch*
13.2	66.6	20.2	-------	6	6	4	1.42	1.45	0.020	24.9	10.4	0.20
6.6	71.4	21.9	1	1	2	1	1.40	1.43	.028	35.2	13.5	.16
14.8	61.0	24.3	6	1	7	4	1.37	1.40	.023	26.4	13.6	.17
25.9	57.2	16.9	12	13	25	15	1.31	1.42	.028	30.7	11.8	.21
21.6	63.3	15.1	8	5	13	7	1.32	1.32	.024	29.1	11.3	.22
20.6	66.3	13.1	16	1	17	11	1.39	1.40	.019	25.3	11.3	.16
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
4.3	80.8	14.8	-------	2	2	1	1.54	1.54	.010	19.3	6.7	.19
3.7	75.3	21.1	-------	2	2	1	1.48	1.49	.025	21.7	9.8	.18
3.8	68.8	27.4	-------	3	3	2	1.44	1.45	.028	20.2	12.4	.11
3.7	82.3	14.0	-------	6	6	4	1.38	1.54	.018	26.6	7.5	.25
3.9	80.5	15.7	2	7	9	5	1.45	1.47	.032	21.7	8.3	.18
11.6	65.3	23.1	22	42	64	50	1.37	1.72	.032	32.1	10.9	.14
12.5	62.6	25.0	(1)	14	33	22	1.40	1.62	.040	31.0	13.7	.17
22.9	55.9	21.1	(2)	32	57	44	-------	-------	-------	-------	9.2	-------
7.1	73.4	19.5	-------	5	5	4	1.53	1.54	.007	22.5	9.5	.19
2.1	61.2	36.7	-------	-------	-------	-------	1.37	1.37	.044	24.8	15.8	.14
6.3	73.8	19.8	-------	-------	-------	-------	1.46	1.46	.019	20.0	10.1	.14
7.9	73.2	18.9	-------	-------	-------	-------	1.49	1.49	.017	20.4	9.9	.16
4.0	79.7	16.4	-------	-------	-------	-------	1.52	1.52	.011	16.8	8.6	.13
3.8	82.1	14.1	-------	-------	-------	-------	1.52	1.52	.017	20.6	8.3	.19
4.3	78.1	17.6	-------	3	3	2	1.50	1.50	.004	19.3	8.9	.15
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
8.6	74.0	17.4	-------	2	2	1	1.32	1.33	.032	21.3	9.8	.15
6.7	74.5	18.9	-------	-------	-------	-------	1.39	1.39	.025	21.3	7.8	.19
7.9	69.9	22.2	1	1	2	1	1.35	1.35	.049	23.1	10.3	.17
10.3	75.8	14.0	1	11	12	8	1.39	1.41	.039	22.9	8.1	.19
6.6	83.0	10.4	-------	1	1	1	1.31	1.31	.025	24.1	7.0	.22
15.9	72.5	11.6	1	12	13	7	1.39	1.43	.021	23.1	8.1	.18
20.6	63.4	16.0	1	16	17	9	1.35	1.41	.017	22.3	8.7	.17
19.6	62.2	18.2	(3)	11	24	16	1.49	1.54	.014	20.2	9.6	.13
11.6	73.0	15.4	-------	-------	-------	-------	1.37	1.37	.017	23.0	7.8	.21
9.3	71.9	18.8	-------	-------	-------	-------	1.40	1.40	.011	22.6	7.4	.21
8.6	73.4	18.1	-------	1	1	1	1.48	1.48	.018	22.8	9.2	.20
6.2	73.6	20.2	-------	-------	-------	-------	1.43	1.43	.012	25.7	10.8	.21
12.0	73.4	14.7	-------	1	1	1	1.49	1.49	.004	22.3	7.3	.22
9.6	73.7	16.7	-------	1	1	1	1.47	1.47	.011	21.4	7.7	.20
11.1	79.4	9.5	-------	-------	-------	-------	1.42	1.42	.007	24.7	6.3	.26
12.7	78.0	9.3	-------	2	2	2	1.46	1.46	.008	24.5	5.1	.2
60.4	28.5	11.1	-------	18	18	12	1.59	1.62	.004	13.6	4.9	.1

TABLE 12.—*Physical properties*

Soil and sample number	Horizon	Depth from surface	Size distribution of particles less than 2 mm in diameter						
			Very coarse sand (2.0 to 1.0 mm)	Coarse sand (1.0 to 0.5 mm)	Medium sand (0.5 to 0.25 mm)	Fine sand (0.25 to 0.10 mm)	Very fine sand (0.10 to 0.05 mm)	Silt (0.02 to 0.002 mm)	Silt (0.005 to 0.002 mm)
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Pope loam:									
S68 Pa 09-1-1	Ap	0-10	0. 1	0. 9	5. 0	16. 8	22. 8	18. 6	3. 5
S68 Pa 09-1-2	B1	10-14	----------	. 2	2. 7	16. 3	27. 1	16. 4	3. 6
S68 Pa 09-1-3	B21	14-19	----------	. 2	2. 5	17. 6	27. 7	16. 4	4. 5
S68 Pa 09-1-4	B22	19-23	----------	. 1	2. 6	23. 6	26. 5	13. 3	2. 3
S68 Pa 09-1-5	B23	23-27	----------	----------	2. 9	23. 7	31. 1	11. 6	2. 9
S68 Pa 09-1-6	B24	27-37	----------	----------	2. 9	36. 0	27. 8	8. 6	2. 8
S68 Pa 09-1-7	B3	37-49	----------	. 2	10. 3	38. 0	26. 4	6. 3	4. 1
S68 Pa 09-1-8	IIC1	49-61	4. 1	15. 0	49. 5	18. 9	5. 5	1. 5	. 4
S68 Pa 09-1-9	IIC2	61-80	4. 3	33. 3	49. 3	7. 9	1. 1	1. 3	. 3
Towhee silt loam:									
S68 Pa 09-12-1	Ap	0-8	. 4	1. 8	1. 9	2. 2	3. 0	40. 3	8. 2
S68 Pa 09-12-2	B21tg	8-11	. 1	. 7	. 7	1. 3	2. 0	42. 8	11. 3
S68 Pa 09-12-3	B22tg	11-21	. 1	. 5	. 9	1. 5	2. 6	35. 4	9. 3
S68 Pa 09-12-4	B23tg	21-28	1. 2	2. 5	2. 3	4. 5	4. 4	30. 2	7. 9
S68 Pa 09-12-5	Bx1	28-39	3. 8	10. 2	9. 1	9. 8	8. 0	18. 5	5. 9
S68 Pa 09-12-6	Bx1	39-53	4. 3	6. 8	5. 6	5. 6	4. 6	9. 5	3. 0
S68 Pa 09-12-7	Bx2	53-63	2. 2	12. 1	12. 8	16. 0	10. 6	18. 3	6. 6
S68 Pa 09-12-8	C1	63-69	6. 9	19. 5	10. 5	9. 0	10. 7	18. 5	7. 2
S68 Pa 09-12-9	C2	69-76	10. 7	24. 6	8. 9	9. 2	9. 3	15. 8	5. 9

[1] 19 percent is larger than 76 millimeters.
[2] 25 percent is larger than 76 millimeters.

TABLE 13.—*Chemical properties*

[Analyses by the Pennsylvania State University Soil Characterization Laboratory.

Soil and sample number	Horizon	Depth from surface	Organic carbon	Nitrogen	Carbon-nitrogen ratio	Calcium-magnesium ratio	Extractable cations (milliequivalents per 100 grams of soil)					
							Calcium	Magnesium	Sodium	Potassium	Total acidity [1]	Aluminum
		Inches	*Percent*	*Percent*								
Bedington silt loam:												
S68 Pa 09-9-1	Ap	0-13	1. 20	0. 11	10. 9	2. 9	3. 2	1. 1	0. 03	0. 82	12. 2	0. 1
S68 Pa 09-9-2	B21t	13-25	. 14	--------	--------	1. 8	4. 5	2. 5	. 11	. 15	9. 2	--------
S68 Pa 09-9-3	B22t	25-38	. 10	--------	--------	. 8	3. 5	4. 4	. 12	. 16	10. 5	. 1
S68 Pa 09-9-4	B23t	38-51	. 11	--------	--------	. 3	1. 6	4. 9	. 11	. 16	14. 7	1. 4
S68 Pa 09-9-5	B24t	51-57	. 08	--------	--------	. 4	2. 0	5. 0	. 09	. 18	14. 0	1. 3
S68 Pa 09-9-6	B3	57-70	. 13	--------	--------	. 4	1. 3	3. 7	. 11	. 19	14. 0	. 6
	R	70	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Chalfont silt loam:												
S68 Pa 09-6-1	Ap	0-10	. 81	. 08	10. 1	2. 3	3. 0	1. 3	. 13	. 14	6. 7	--------
S68 Pa 09-6-2	B21t	10-14	. 17	--------	--------	1. 3	3. 2	2. 4	. 20	. 11	6. 1	. 4
S68 Pa 09-6-3	B22t	14-21	. 18	--------	--------	1. 2	6. 4	5. 3	1. 47	. 14	7. 2	. 1
S68 Pa 09-6-4	Bx1	21-27	. 09	--------	--------	1. 4	5. 3	3. 8	. 39	. 09	3. 9	. 1
S68 Pa 09-6-5	Bx2g	27-33	. 07	--------	--------	1. 5	6. 2	4. 2	. 40	. 10	3. 4	. 1
S68 Pa 09-6-6	IIBx3	33-47	. 11	--------	--------	1. 9	9. 7	5. 2	. 47	. 12	5. 1	. 1
S68 Pa 09-6-7	IIBx4	47-57	. 14	--------	--------	2. 4	12. 8	5. 4	. 43	. 14	4. 2	. 1
S68 Pa 09-6-8	IIC	57-70	. 11	--------	--------	2. 7	10. 5	3. 9	. 34	. 12	3. 8	. 1

of selected soils—Continued

Size distribution of particles less than 2 mm in diameter—Continued: Total sand (2.0 to 0.05 mm)	Total silt (0.05 to 0.002 mm)	Total clay (less than 0.002 mm)	Coarse fragments more than 2 mm in diameter: Percent by weight: 76 to 79 mm	Percent by weight: 19 to 2.0 mm	Percent by weight: Total	Total percent by volume	Bulk density at field moisture content: Material finer than 2 mm	Whole soil including coarse fragments	Coefficient of linear extensibility	Material finer than 2 mm that has moisture held at tension of—: One-third bar	15 bars	Available water of whole soil
Percent	*Percent*	*Percent*					*Grams per cubic centimeter*	*Grams per cubic centimeter*		*Percent*	*Percent*	*Inches per inch*
45.7	42.3	12.0	--------	1	1	1	1.45	1.45	.011	16.4	5.3	0.16
46.3	41.2	12.5	--------	--------	--------	--------	1.55	1.55	.010	15.0	5.4	.15
48.0	41.3	10.7	--------	--------	--------	--------	1.51	1.51	.005	14.0	5.3	.13
52.8	36.7	10.5	--------	--------	--------	--------	1.48	1.48	.012	13.9	4.2	.14
57.7	34.5	7.8	--------	--------	--------	--------	1.49	1.49	.010	11.5	3.3	.12
66.6	27.6	5.8	--------	--------	--------	--------	1.50	1.50	.005	8.7	2.7	.09
74.9	21.3	3.8	--------	--------	--------	--------	1.55	1.55	.007	8.4	1.9	.10
93.0	5.4	1.6	36	29	65	53	--------	--------	--------	--------	--------	--------
95.8	2.9	1.2	34	23	57	44	--------	--------	--------	--------	--------	--------
9.2	76.6	14.2	7	--------	7	4	1.47	1.47	.020	31.2	8.4	.34
4.8	71.6	23.6	--------	1	1	1	1.50	1.50	.017	26.4	10.9	.23
5.6	66.5	27.8	--------	41	41	29	1.48	1.48	.045	25.1	15.8	.09
14.8	55.3	29.9	--------	23	23	12	1.33	1.36	.064	29.6	18.5	.13
40.9	45.1	14.0	--------	24	24	15	1.50	1.52	.022	22.0	14.1	.10
26.9	64.4	8.7	1	10	11	7	1.50	1.52	.025	22.0	11.7	.14
53.7	32.0	14.4	--------	9	9	6	1.56	1.57	.007	20.9	11.3	.14
56.6	29.6	13.8	--------	16	16	10	1.56	1.65	.014	22.3	12.5	.14
62.7	26.6	10.7	--------	--------	--------	--------	1.43	1.43	.018	23.7	11.9	.17

[3] 13 percent is larger than 76 millimeters.

of selected soils

Dashes in columns indicate material not present or determination not made]

Cation exchange capacity (sum)	Base saturation (sum)	Soil reaction in a 1:1 solution of—: Water	Potassium chloride	Calcium chloride	Free iron oxides	Mineral composition of clay fraction: Kaolinite	Illite	Vermiculite	Montmorillonite	Chlorite	Interstratified
(Milliequivalent/100 grams of soil	*Percent*	*pH*	*pH*	*pH*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
17.3	29.7	5.2	4.1	5.0	2.4	25	30	25	--------	--------	20
16.5	44.1	5.8	4.7	5.6	3.5	20	40	25	--------	10	5
18.7	43.8	5.6	4.4	5.4	4.4	25	45	30	--------	--------	--------
21.5	31.5	4.8	3.1	4.3	5.1	25	45	20	5	--------	5
21.3	34.2	5.0	3.0	4.4	3.6	--------	--------	--------	--------	--------	--------
19.3	27.5	5.0	3.4	4.5	4.7	25	30	30	--------	--------	15
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
11.3	40.6	5.9	4.4	5.0	1.5	25	25	40	--------	5	5
12.0	49.2	5.9	4.0	5.0	3.0	30	35	30	5	--------	--------
20.5	64.9	6.4	4.4	5.4	2.9	30	30	15	25	--------	--------
13.5	71.1	6.8	5.1	5.6	2.1	25	35	5	35	--------	--------
14.3	76.2	7.0	5.1	5.8	2.1	20	35	--------	45	--------	--------
20.6	75.2	7.2	5.1	5.9	2.2	10	45	5	40	--------	--------
23.0	81.7	7.5	5.2	6.6	2.6	--------	--------	--------	--------	--------	--------
18.7	79.6	6.8	5.2	6.4	2.6	5	45	10	40	--------	--------

TABLE 13.—*Chemical properties*

Soil and sample number	Horizon	Depth from surface	Organic carbon	Nitrogen	Carbon-nitrogen ratio	Calcium-magnesium ratio	Extractable cations (milliequivalents per 100 grams of soil)					
							Calcium	Magnesium	Sodium	Potassium	Total acidity [1]	Aluminum
		Inches	*Percent*	*Percent*								
Doylestown silt loam:												
S68 Pa 09-8-1	Ap	0-11	1. 34	0. 13	10. 3	2. 8	5. 1	1. 8	0. 12	0. 38	9. 2	--------
S68 Pa 09-8-2	B2tg	11-20	. 23	--------	--------	1. 1	5. 2	4. 7	. 33	. 17	9. 6	. 7
S68 Pa 09-8-3	Bxlg	20-25	. 11	--------	--------	. 9	4. 1	4. 6	. 42	. 13	7. 0	. 2
S68 Pa 09-8-4	Bx2g	25-32	. 10	--------	--------	1. 0	4. 6	4. 8	. 45	. 13	5. 5	. 1
S68 Pa 09-8-5	Bx3g	32-38	. 10	--------	--------	. 9	4. 1	4. 4	. 44	. 11	4. 9	--------
S68 Pa 09-8-6	Bx4g	38-45	. 09	--------	--------	1. 1	4. 1	3. 8	. 39	. 11	4. 5	--------
S68 Pa 09-8-7	Bx5g	45-53	. 09	--------	--------	1. 1	4. 8	4. 3	. 45	. 13	4. 1	--------
	IIR	53	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Duncannon silt loam:												
S68 Pa 09-5-1	Ap	0-10	1. 94	. 17	11. 4	5. 7	2. 3	. 4	. 08	. 38	8. 6	. 6
S68 Pa 09-5-2	B1	10-17	. 33	. 04	8. 2	5. 5	2. 2	. 4	. 11	. 17	3. 8	. 6
S68 Pa 09-5-3	B21t	17-24	. 21	--------	--------	2. 1	3. 0	1. 4	. 11	. 18	3. 6	. 6
S68 Pa 09-5-4	B22t	24-34	. 11	--------	--------	1. 4	2. 2	1. 6	. 12	. 15	5. 7	. 6
S68 Pa 09-5-5	B3	34-45	. 12	--------	--------	1. 1	1. 7	1. 6	. 10	. 14	7. 4	. 6
S68 Pa 09-5-6	IIC1	45-49	. 09	--------	--------	. 8	2. 2	2. 8	. 13	. 16	8. 2	. 8
S68 Pa 09-5-7	IIC2	49-56	. 09	--------	--------	. 7	2. 4	3. 6	. 15	. 16	5. 7	1. 1
S68 Pa 09-5-8	IIIC3	56-68	. 09	--------	--------	. 7	2. 7	3. 8	. 16	. 17	6. 3	. 9
Lawrenceville silt loam:												
S68 Pa 09-3-1	Ap	0-11	1. 30	. 11	11. 8	4. 0	5. 2	1. 3	. 11	. 39	5. 3	. 4
S68 Pa 09-3-2	B21t	11-19	. 14	--------	--------	2. 1	2. 3	1. 1	. 09	. 16	3. 7	. 5
S68 Pa 09-3-3	B22t	19-25	. 15	--------	--------	1. 5	2. 8	1. 9	. 14	. 13	5. 3	. 7
S68 Pa 09-3-4	Bx1	25-34	. 11	--------	--------	1. 0	1. 8	1. 8	. 12	. 13	8. 6	2. 0
S68 Pa 09-3-5	Bx2	34-40	. 09	--------	--------	. 8	1. 6	2. 0	. 11	. 13	6. 4	1. 1
S68 Pa 09-3-6	Bx3	40-47	. 10	--------	--------	. 7	1. 6	2. 3	. 11	. 13	6. 3	1. 0
S68 Pa 09-3-7	C1	47-57	. 07	--------	--------	. 8	1. 6	2. 0	. 11	. 12	6. 6	1. 0
S68 Pa 09-3-8	C2	57-72	. 08	--------	--------	. 9	1. 6	1. 8	. 10	. 11	5. 0	. 9
S68 Pa 09-3-9	IIC3	72-81	. 05	--------	--------	1. 0	2. 1	2. 2	. 21	. 12	3. 8	1. 0
Pope loam:												
S68 Pa 09-1-1	Ap	0-10	. 86	. 08	10. 8	6. 9	1. 2	. 2	. 08	. 10	4. 4	. 7
S68 Pa 09-1-2	B1	10-14	. 23	. 03	7. 7	4. 5	. 9	. 2	. 09	. 10	2. 2	. 7
S68 Pa 09-1-3	B21	14-19	. 17	--------	--------	3. 3	1. 0	. 3	. 08	. 10	2. 0	. 6
S68 Pa 09-1-4	B22	19-23	. 15	--------	--------	3. 0	. 9	. 3	. 06	. 09	2. 0	. 7
S68 Pa 09-1-5	B23	23-27	. 09	--------	--------	2. 7	. 8	. 3	. 06	. 08	2. 0	. 6
S68 Pa 09-1-6	B24	27-37	. 07	--------	--------	5. 0	1. 0	. 2	. 07	. 09	2. 4	. 4
S68 Pa 09-1-7	BI3	37-49	. 05	--------	--------	7. 0	. 7	. 1	. 08	. 08	2. 4	. 3
S68 Pa 09-1-8	IC1	49-61	. 04	--------	--------	--------	. 1	--------	. 08	. 08	2. 7	. 6
S68 Pa 09-1-9	IIC2	61-80	. 04	--------	--------	--------	. 1	--------	. 06	. 08	2. 5	. 6
Towhee silt loam:												
S68 Pa 09-12-1	Ap	0-8	1. 41	. 13	10. 8	3. 2	4. 8	1. 5	. 08	. 14	8. 5	. 3
S68 Pa 09-12-2	B21tg	8-11	. 32	. 04	8. 0	1. 4	6. 1	4. 3	. 11	. 15	5. 7	. 4
S68 Pa 09-12-3	B22tg	11-21	. 24	. 04	6. 0	1. 2	9. 8	8. 5	. 15	. 17	7. 4	. 4
S68 Pa 09-12-4	B23tg	21-28	. 16	--------	--------	1. 3	13. 8	10. 7	. 20	. 20	8. 6	. 4
S68 Pa 09-12-5	Bx1	28-39	. 13	--------	--------	1. 1	6. 2	5. 8	. 20	. 14	10. 2	. 3
S68 Pa 09-12-6	Bx1	39-53	. 08	--------	--------	1. 2	6. 0	5. 1	. 23	. 10	9. 9	. 3
S68 Pa 09-12-7	Bx2	53-63	. 08	--------	--------	1. 2	6. 6	5. 3	. 33	. 09	10. 1	. 3
S68 Pa 09-12-8	C1	63-69	. 04	--------	--------	1. 1	8. 6	8. 0	. 41	. 11	8. 2	. 3
S68 Pa 09-12-9	C2	69-76	. 05	--------	--------	1. 2	7. 5	6. 3	. 54	. 16	8. 4	. 1

[1] Extractable aluminum is included in the total acidity column.

of selected soils—Continued

Cation exchange capacity (sum)	Base saturation (sum)	Soil reaction in a 1:1 solution of—			Free iron oxides	Mineral composition of clay fraction					
		Water	Potassium chloride	Calcium chloride		Kaolinite	Illite	Vermiculite	Montmorillonite	Chlorite	Interstratified
(Milliequivalent/100 grams of soil	*Percent*	*pH*	*pH*	*pH*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
16.6	44.6	5.1	4.1	5.0	2.1	30	20	35	----------	5	10
20.0	52.0	5.3	3.7	5.0	2.4	30	30	15	20	5	----------
16.2	56.9	5.4	3.7	5.0	2.3	25	35	10	30	----------	----------
15.5	64.5	5.7	3.9	5.3	3.1	20	35	5	40	----------	----------
13.9	64.9	6.0	4.1	5.4	3.0	20	40	10	30	----------	----------
12.9	65.1	6.1	4.2	5.5	2.1	----------	----------	----------	----------	----------	----------
13.8	70.2	6.3	4.2	5.3	2.5	20	40	10	30	----------	----------
----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
11.8	26.9	5.4	4.0	4.6	1.6	30	20	30	----------	10	10
6.7	43.1	5.8	4.2	4.9	2.0	30	20	30	----------	10	10
8.3	56.6	6.0	4.4	5.1	3.0	30	30	25	----------	10	5
9.8	41.7	6.1	4.4	5.2	2.8	30	35	20	----------	10	5
10.9	32.4	6.2	4.4	5.2	2.5	25	40	15	10	10	----------
13.5	39.2	6.1	4.2	5.2	2.6	25	45	15	10	----------	5
12.0	52.5	6.0	3.9	5.0	2.8	25	55	10	10	----------	----------
13.1	52.0	5.8	3.7	4.9	2.9	25	55	5	15	----------	----------
12.3	56.9	6.3	5.6	5.9	1.4	20	25	40	----------	10	5
7.3	49.7	6.7	5.3	6.2	1.7	20	25	30	----------	10	15
10.3	48.4	6.4	4.7	5.9	2.0	20	35	25	10	5	5
12.4	30.9	5.1	3.6	4.9	2.3	20	40	20	15		5
10.2	37.5	5.4	3.7	4.5	2.6	20	40	30	10	----------	----------
10.4	39.7	5.4	3.6	4.6	2.4	----------	----------	----------	----------	----------	----------
10.4	36.7	5.3	3.7	4.6	2.1	25	35	30	10	----------	----------
8.6	41.9	5.4	3.7	4.6	1.2	25	45	20	10	----------	----------
8.4	54.9	5.1	3.6	4.5	1.5	10	50	15	25	----------	----------
6.0	26.4	5.0	4.4	4.9	1.4	----------	60	----------	----------	35	5
3.5	37.0	5.4	4.6	5.2	1.4	----------	60	10	----------	25	5
3.5	42.5	5.3	4.6	5.3	1.5	----------	65	----------	----------	30	----------
3.3	40.3	5.8	4.6	5.4	1.5	----------	----------	----------	----------	----------	----------
3.2	38.3	5.8	4.7	5.5	1.3	----------	40	30	----------	15	15
3.8	36.2	5.8	4.7	5.7	1.0	----------	----------	----------	----------	----------	----------
3.4	28.6	5.9	4.9	5.5	.9	----------	35	35	----------	15	15
3.0	8.8	6.2	5.0	5.7	.7	----------	35	35	----------	15	15
2.7	8.8	6.2	4.9	5.6	.8	----------	50	15	----------	15	15
15.0	43.4	6.2	4.5	5.5	1.7	20	20	55	----------	----------	5
16.4	65.2	6.5	4.6	5.7	1.4	20	25	25	30	----------	----------
26.0	71.6	6.5	4.6	5.9	1.3	15	25	15	45	----------	----------
33.5	74.3	6.6	4.7	6.0	2.6	15	20	10	55	----------	----------
22.5	54.7	7.0	5.0	6.1	4.9	25	20	10	45	----------	----------
21.3	53.6	7.1	5.1	6.2	4.6	25	20	15	40	----------	----------
22.4	55.0	7.3	5.1	6.3	5.0	30	20	10	40	----------	----------
25.3	67.6	7.3	4.9	6.3	1.4	----------	----------	----------	----------	----------	----------
22.9	63.3	7.2	4.8	6.3	1.1	35	15	10	40	----------	----------

and an increasing quantity of illite with depth. This is due to the conversion of illite to vermiculite during soil formation. In the lower horizons that are derived from sedimentary rock, illite is dominant and vermiculite and montmorillonite are secondary in abundance. The quantity of kaolinite and montmorillonite is also significant. The mineralogy of the lower horizons in the Duncannon profile appears to be an inherited feature. The quantity and distribution of clay minerals in the Lawrenceville profile is very similar to that of the Duncannon soil. The clay minerals in the Chalfont profile are similar in quantity and distribution of illite, vermiculite, and kaolinite to the Lawrenceville profile. The major difference is the Chalfont profile has a larger quantity of montmorillonite that is closer to the surface. This is a result of the synthesis of montmorillonite in Chalfont soils during soil formation. The mineralogy of the Doylestown profile is about the same as the Chalfont profile, but the zone of montmorillonite concentration tends to be closer to the surface.

Pope soils formed in alluvial sediments. The Pope profile contains illite as the predominant clay mineral. Secondary in abundance are vermiculite, chlorite, and intergrade vermiculite-chlorite. The mineral distribution in this profile indicates significant stratification of the parent material.

Towhee soils formed in material weathered from diabase rock. The profile of this soil contains kaolinite, illite, vermiculite, and montmorillonite as the major clay minerals. The lower horizons have more kaolinite than the upper horizons, and the inverse is true of vermiculite. The amount of illite is nearly constant with depth. Montmorillonite is lacking or significantly lower in quantity in the upper horizons than in the rest of the profile. The mineralogy of the Towhee profile, except for illite, is a result of weathering of the primary minerals and synthesis of secondary clay minerals. Illite may be inherited from the parent diabase rock.

Bedington soils formed in material weathered from sedimentary rock. The upper horizons, however, have probably been influenced by the deposition of silty, wind-deposited sediment. The mineralogy of the Bedington profile shows that kaolinite, illite, and vermiculite are the predominant clay minerals.

Environmental Factors Affecting Soil Use

Bucks and Philadelphia Counties are rich in American history, dating back 160 years before the Declaration of Independence. In 1616, the Dutch started exploring Philadelphia County and southern Bucks County. William Penn founded and named both Philadelphia and Bucks Counties.

Philadelphia was the capital and the center of activities for the colonies during the Revolutionary War. Opposing armies often traveled across Bucks County. During the eighteenth and nineteenth centuries Philadelphia developed into a major shipping port and industrial center, but Bucks County remained largely agrarian. Urbanization and industrialization of Bucks County began mainly after World War II. Most of the townships in the southern part of the county are urbanized to a degree where farming is now of minor importance.

In the period 1950 to 1960, the population of Bucks County increased from 144,680 to 308,567, an increase of 113.3 percent. Bucks County continued its population trend for the next 10 years, and by 1970 the population was 415,056. Population in Philadelphia County at the same time was decreasing from 2,071,650 in 1950 to 2,002,512 in 1960 and to 1,948,609 in 1970.

The pressure of urban expansion is rapidly changing the way farmland is used in Bucks County. Much of the county is now characterized by country estates and part-time farms. The number of farms is decreasing, but the size of farms is increasing (fig. 32). According to the U.S. Census of Agriculture, there were 2,730 farms in 1954 and only 1,159 in 1969, but the average size of farm increased from 84.3 to 113.2 acres. In 1969, 989 of these farms had 78,574 acres of harvested crops. The principal field crops were corn (23,787 acres for grain and 4,744 acres for silage), hay (20,469 acres), soybeans (9,080 acres), and wheat (8,002 acres).

In 1969 there were 18,834 cattle and calves on farms in the county, and 9,616 of these were milk cows. Other livestock included 6,411 hogs and pigs and 1,391 sheep and lambs. Poultry numbered 400,799.

Many major highways pass through Bucks and Philadelphia Counties. The area has the east-west Pennsylvania Turnpike and the northeast extension of the turnpike. U.S. Highways 1 and 13 and Interstate 95 pass north and south through the two counties.

Bucks County has rail service and seven local airports. Philadelphia has two large airports and is a stopover for two of the transatlantic lines. The Philadelphia area is served by five air-freight liners and numerous domestic railroad lines. Train service is available to New York, Baltimore, Washington, D.C., and other points south and west.

Climate[7]

Bucks and Philadelphia Counties are in the extreme southeast part of Pennsylvania and are a part of the Southeast Piedmont climatic division. The climate is classified as humid continental modified by the Atlantic Ocean. Most of the weather systems that affect this area either develop in the Midwest and are steered eastward by the prevailing westerly flow aloft, or they form in southeastern States and move northeastward parallel to the Atlantic Coast. The long overland trajectory greatly modifies the Midwest weather systems so that by the time they reach southeastern Pennsylvania they have warmed and gained moisture from the Gulf of Mexico or the Atlantic Ocean.

Data in this climatic summary are from the Quakertown-Perkasie weather station, which is representative of Bucks County, and the Philadelphia International Airport station. Table 14 gives temperature and pre-

[7] By PAUL DAILY, climatologist for Pennsylvania, National Weather Service, U.S. Department of Commerce.

Figure 32.—Winter grain on one of the few remaining areas of farmland in Lower Southampton Township in Bucks County. The soil is Chester silt loam.

cipitation data for the two counties. Table 15 gives the probable dates of freezing temperatures.

The topography is rolling and hilly. Elevations in Philadelphia and southern Bucks Counties range from near sea level to 400 feet. Elevations in northern Bucks County are more extreme, generally in the 300 to 700 feet category, but actually range from near 100 feet along the Delaware River to more than 900 feet on Haycock Mountain.

The average annual temperature is more than 54° F. in Philadelphia and the extreme southern part of Bucks County. It is between 52° and 53° in the rest of Bucks County and grades to slightly lower from south to north. The warmer temperatures are caused by the "heat island" effect of the lower lying metropolitan area, and the cooler readings are experienced at higher elevations in northern Bucks County. Daytime highs are not influenced by the heat of the city, and nighttime lows are usually 5 to 10 degrees higher in the city than in the suburban and rural areas of Bucks County. Precipitation tends to follow the topographical features. An average of 40 to 42 inches falls annually in low-lying Philadelphia and the extreme southern part of Bucks County, and 43 to 45 inches falls in the rest of Bucks County. Orographic uplift, or mountain deflection of moisture-laden winds, probably is the reason for the slightly greater totals at higher elevations.

Infrequent air mass changes and a decided maritime influence make summers warm and humid. Daytime highs reach or exceed 90° on an average of 17 days at both Quakerstown-Perkasie and the Philadelphia Airport. The record highs of 106° at Philadelphia and 105° at Quakertown were set on the same date, August 7, 1918. Daytime highs average in the mid eighties, and nighttime lows normally range from the upper fifties in northern Bucks County to the mid sixties in Philadelphia. Cloud cover is at a minimum in summer, because the survey area receives more than 60 percent of available sunshine, and nights are generally clear. The prevailing wind is from the south-southwest and averages 8 miles per hour. Summer rainfall is generally in the form of thundershowers that occur on the average on 21 days from June to August.

Cloudiness is more prevalent in winter than in other seasons because cold fronts and coastal low pressure systems are more frequent. Prevailing winds are from the west-northwest and average 10 to 12 miles per hour. Daytime highs average near 40° and nighttime lows range from near 20° in northern Bucks County to the mid twenties in Philadelphia. Temperatures of 70° have

TABLE 14.—*Temperature and precipitation*

Philadelphia International Airport, Pennsylvania, 1941–70

Month	Temperature				Precipitation					
	Average daily maximum	Average daily minimum	Average extreme maximum	Average extreme minimum	Average total	One year in 10 will have— Less than—	One year in 10 will have— More than—	Average snowfall	Average number of days with snow cover of— 1 inch or more	Average number of days with snow cover of— 6 inches or more
	° F	*° F*	*° F*	*° F*	*Inches*	*Inches*	*Inches*	*Inches*		
January	39	25	58	9	2.8	1.57	4.68	5.6	6	1
February	41	26	60	10	2.6	1.76	3.55	6.2	4	1
March	50	33	72	19	3.7	1.94	5.27	4.3	2	(1)
April	63	42	84	30	3.3	1.57	5.22	.1	(1)	0
May	73	52	89	39	3.4	1.01	5.91	0	0	0
June	82	61	94	50	3.7	.71	5.89	0	0	0
July	86	67	96	56	4.1	1.24	7.16	0	0	0
August	84	65	93	53	4.0	1.24	6.58	0	0	0
September	78	58	91	43	3.2	1.33	5.82	0	0	0
October	67	47	83	32	2.5	1.13	4.38	(2)	0	0
November	55	37	72	23	3.4	1.64	5.69	.8	(1)	(1)
December	42	27	62	12	3.3	1.76	5.26	4.6	4	1
Annual	63	45	3 104	4 −5	40.0	33.03	46.62	21.6	16	3

Quakertown-Perkasie, Bucks County, Pennsylvania, 1941–70

Month	Average daily maximum	Average daily minimum	Average extreme maximum	Average extreme minimum	Average total	Less than—	More than—	Average snowfall	1 inch or more	6 inches or more
January	38	20	56	0	3.2	1.24	4.92	8.3	13	4
February	40	21	56	2	2.8	1.71	4.31	8.4	11	2
March	50	28	70	12	3.9	2.65	5.31	6.4	4	1
April	63	38	82	24	3.9	1.55	6.43	.1	(1)	0
May	74	47	87	32	4.0	1.37	8.75	0	0	0
June	81	56	93	42	3.5	1.56	5.63	0	0	0
July	85	61	94	48	4.4	.88	6.83	0	0	0
August	83	59	92	44	4.3	1.53	8.27	0	0	0
September	77	52	90	34	3.5	1.50	6.56	0	0	0
October	67	41	82	25	3.0	1.27	5.09	0	0	0
November	53	33	69	17	3.9	1.88	6.13	1.0	1	(1)
December	40	23	59	3	3.9	1.78	5.76	7.4	8	2
Annual	63	40	3 103	4 −12	44.3	34.95	51.96	31.6	37	9

1 Less than 0.5.
2 Trace.
3 Average annual highest temperature.
4 Average annual lowest temperature.

been experienced in the middle of winter, but such occurrences are rare and short lived. Subzero readings average less than once annually in Philadelphia and only 4 times annually in northern Bucks County. The record low for Philadelphia was −11° and for Quakertown −20°, both on February 25, 1934.

Average annual snowfall is only slightly more than 20 inches in Philadelphia compared with the more than 30 inches in much of Bucks County. An inch or more of snow on the ground is observed on 37 days each winter in Quakertown but only on 16 days in Philadelphia. Snow cover generally persists for only short periods. The longest period of snow cover at Quakertown was 71 days from December 18, 1944, to February 26, 1945. Snow cover is more frequent and stays for longer periods on north- and east-facing slopes of the many hills in the area.

The first snowfall of any significance generally occurs in December. Individual snowstorms seldom exceed 5 to 10 inches although a few snowfalls of 20 inches or more have occurred. The greatest snow depth observed at Quakertown was 27 inches on December 31, 1966. The winter storms most conducive to heavy snows in this region are the east coast low-pressure centers that move up from the Carolinas. Very little snow falls after the middle of March.

Spring and fall are transition periods. Early in May the average maximum temperature approaches 70°. This 70° or higher persists through summer to early in October. The prevailing wind is west-northwest in spring and west-southwest in fall and averages 8 to 12 miles per hour.

The growing season is more than 190 days in the Philadelphia area, about 175 days in southern Bucks County, and around 155 days in the northern part of Bucks County. The average date of the last spring frost is May 30 in the Quakertown-Perkasie area and April 15 in Philadelphia. The average date of the first fall frost is October 5 in the Quakertown-Perkasie area and October 30 in Philadelphia.

TABLE 15.—*Probabilities of last freezing temperatures in spring and first in fall*

Philadelphia International Airport, Pennsylvania

Probability	Dates of given probability for temperatures of—				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	March 11	March 20	March 29	April 14	April 16
2 years in 10 later than	March 4	March 13	March 27	April 5	April 13
5 years in 10 later than	February 20	March 1	March 17	March 27	April 5
Fall:					
1 year in 10 earlier than	December 9	November 24	November 15	October 25	October 8
2 years in 10 earlier than	December 12	November 30	November 21	November 3	October 21
5 years in 10 earlier than	December 19	December 9	November 27	November 15	October 30
Quakertown-Perkasie, Bucks County, Pennsylvania					
Spring:					
1 year in 10 later than	March 30	April 4	April 14	April 26	May 14
2 years in 10 later than	March 20	March 31	April 6	April 23	May 10
5 years in 10 later than	March 11	March 24	March 30	April 13	May 4
Fall:					
1 year in 10 earlier than	November 21	November 4	October 11	September 29	September 23
2 years in 10 earlier than	November 23	November 8	October 19	October 6	September 25
5 years in 10 earlier than	December 2	November 16	November 4	October 17	October 5

Thunderstorms occur in all seasons. On the average, thunder is noted on 9 days in spring, 21 days in summer, 4 in fall, and 1 during winter. Tropical storms and hurricanes have been known to pass over or near this area, but such occurrences are rare. Winds from these storms can exceed 60 miles per hour this far inland. but the primary threat is flooding as a result of the accompanying heavy rains that deluge the region with as much as 3 to 6 inches in a 24- to 48-hour period. Damage from wind and hail associated with severe thunderstorms is usually recorded somewhere in Bucks and Philadelphia Counties each year. Since 1854 when records were first kept on tornadoes, 10 have been sighted in Bucks County and 9 in Philadelphia County. The worst, on August 3, 1885, killed two and injured 45 in Philadelphia.

Geology

Rocks underlying Bucks and Philadelphia Counties had their origin millions of years ago as layers of sand, gravel, silt, and lime materials were deposited. Subjected to pressure, cementation, and heat for long periods of time, these layers evolved into schist, gneiss, shale, sandstone, quartzite, conglomerate, and limestone. Subsequent faulting, tilting, folding, and uplift, followed by deep-cut erosion, exposed the rocks and shaped the landscape.

Minerals produced in Bucks and Philadelphia Counties are sand and gravel; crushed stone; building, ornamental, and other dimension stone; lime and clay.

Sand and gravel are among the most valuable mineral products of Bucks County. The bulk of the sand and gravel is from the Quaternary deposits in the Yardley-Morrisville-Tullytown area. Lesser amounts are produced along the Delaware River as far north as Riegelsville.

Crushed stone is produced from limestone, red and black sandstone, argillite and shale (fig. 33), metamorphosed gray-black shales, and diabase stones. All except the limestone are quarried in the Triassic areas.

Diabase, red sandstone, dark gray argillite, metamorphosed shale, quartzite, schist, and gneiss are used in the production of dimension stone. Most of these are used locally but a few, particularly the diabase, are in wide demand. Of minor importance is the production of lime from limestone and dolomite in Bucks County. It occurs, to a limited extent, in the Durham and Buckingham areas.

Water Supply

The densely populated townships in south and south central Bucks County, as well as most of the boroughs, have public water supply. This water is supplied by deep wells or by collection of surface water into reservoirs. The rest of Bucks County relies on shallow wells and springs for water. Philadelphia County obtains most of its water from the Delaware and the Schuylkill Rivers.

The underlying rocks in Bucks County yield varying amounts of water for public use. Areas underlain by shale and diabase often produce only a small amount of water.

Reservoirs are planned for construction in Core Creek and North Branch of Neshaminy Creek for additional water supply. They will be supplemented by water pumped from the Delaware River.

Figure 33.—Aerial view of stone quarry in the Lockatong Formation. Nearby fields are mostly Abbottstown and Readington soils.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in atmosphere; but that in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Channery soil. A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Cobblestone. A rounded or partly rounded fragment of rock, 3 to 10 inches in diameter.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of step slopes.

Conglomerate. Rock composed of gravel and rounded stones cemented together by hardened clay, lime, iron oxide, or silica.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Contour stripcropping. Growing crops in strips that follow the contour or are parallel to terraces or diversions. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cover crop. A close-growing crop grown primarily to improve and to protect the soil between periods of regular crop production; or a crop grown between trees and vines in orchards and vineyards.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Fragipan. A loamy, brittle subsurface horizon that is very low in organic-matter content and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, it tends to rupture suddenly if pressure is applied. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur 15 to 40 inches below the surface.

Gleyed soil. A soil in which waterlogging and lack of oxygen have caused the material in one or more horizons to be neutral gray in color. The term "gleyed" is applied to soil horizons with yellow and gray mottling caused by intermittent waterlogging.

Gravelly soil material. From 15 to 50 percent of material, by volume, consists of rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter.

Green manure (agronomy). A crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

High water table. A zone of saturation in the soil that is within 6 inches of the surface in most seasons. It may be caused by a normal ground water table or a perched water table. The presence of a high water table is indicated by mottling within 6 inches of the soil surface. It occurs in poorly drained and very poorly drained soils.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters

(about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid*, and *very rapid*.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Seasonal high water table. A zone of saturation in the soil that is within 6 to 36 inches of the soil surface during at least part of the year. A seasonal high water table is usually caused by a fluctuating water table generally not associated with the normal ground water table. It is indicated by mottling within 6 to 36 inches of the soil surface. It occurs in somewhat poorly drained and moderately well drained soils.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lowest limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stones. Rock fragments greater than 10 inches in diameter if rounded, and greater than 15 inches along the longer axis if flat.

Stripcropping. Growing crops in a systematic arrangement of strips, or bands, to serve as vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which it belongs. In referring to a capability unit, read the introduction to the section it is in for general information about management. Other information is given in tables as follows:

Estimated yields, table 1, page 20.
Woodland, table 2, page 24.
Engineering, tables 4, 5, and 6, pages 36 to 53.
Community development, table 7, page 56.
Recreation, table 8, page 64.
Acreage and extent, table 9, page 72.

Map symbol	Mapping unit	Described on page	Capability unit	
			Symbol	Page
AbA	Abbottstown silt loam, 0 to 3 percent slopes	74	IIIw-1	16
AbB	Abbottstown silt loam, 3 to 8 percent slopes	74	IIIw-1	16
AbC	Abbottstown silt loam, 8 to 15 percent slopes	75	IIIe-6	16
AdB	Allenwood gravelly silt loam, 3 to 8 percent slopes	76	IIe-3	13
AdC	Allenwood gravelly silt loam, 8 to 15 percent slopes	76	IIIe-2	15
AdD	Allenwood gravelly silt loam, 15 to 25 percent slopes	76	IVe-1	16
Ae	Alluvial land	76	VIIs-4	18
AgA	Alton gravelly loam, 0 to 3 percent slopes	77	IIIs-1	16
AgB	Alton gravelly loam, 3 to 8 percent slopes	77	IIIs-1	16
AlA	Alton gravelly loam, flooded, 0 to 5 percent slopes	78	IIIw-4	16
BeA	Bedington silt loam, 0 to 3 percent slopes	78	I-2	12
BeB	Bedington silt loam, 3 to 8 percent slopes	78	IIe-2	13
BeC	Bedington silt loam, 8 to 15 percent slopes	78	IIIe-1	15
Bo	Bowmansville silt loam	80	IVw-1	18
CaA	Chalfont silt loam, 0 to 3 percent slopes	80	IIIw-1	16
CaB	Chalfont silt loam, 3 to 8 percent slopes	81	IIIw-1	16
CeA	Chester silt loam, 0 to 3 percent slopes	82	I-2	12
CeB	Chester silt loam, 3 to 8 percent slopes	82	IIe-2	13
CeC	Chester silt loam, 8 to 15 percent slopes	82	IIIe-1	15
CeD	Chester silt loam, 15 to 25 percent slopes	82	IVe-1	16
ChD	Chester extremely stony loam, 8 to 25 percent slopes	82	VIIs-1	18
ClB	Clarksburg silt loam, 2 to 6 percent slopes	83	IIe-5	14
CwB	Culleoka-Weikert shaly silt loams, 3 to 8 percent slopes	83	IIIe-4	15
CwC	Culleoka-Weikert shaly silt loams, 8 to 15 percent slopes	83	IVe-3	17
DoA	Doylestown silt loam, 0 to 3 percent slopes	85	IVw-2	18
DoB	Doylestown silt loam, 3 to 8 percent slopes	85	IVw-2	18
DsB	Duffield silt loam, 2 to 8 percent slopes	85	IIe-2	13
DtC	Duffield and Washington soils, 8 to 20 percent slopes	85	IIIe-1	15
DuA	Duncannon silt loam, 0 to 3 percent slopes	86	I-2	12
DuB	Duncannon silt loam, 3 to 8 percent slopes	87	IIe-2	13
Fa	Fallsington silt loam, gravelly subsoil variant	88	IIIw-2	16
Ha	Hatboro silt loam	88	IVw-1	18
HoA	Howell silt loam, 0 to 3 percent slopes	90	I-3	12
HoB	Howell silt loam, 3 to 8 percent slopes	90	IIe-3	13
KlB	Klinesville very shaly silt loam, 3 to 8 percent slopes	90	IIIe-4	15
KlC	Klinesville very shaly silt loam, 8 to 15 percent slopes	90	IVe-3	17
KlD	Klinesville very shaly silt loam, 15 to 25 percent slopes	90	VIe-1	18
LaA	Lansdale loam, 0 to 3 percent slopes	92	I-3	12
LaB	Lansdale loam, 3 to 8 percent slopes	92	IIe-3	13
LaC	Lansdale loam, 8 to 15 percent slopes	92	IIIe-2	15
LaD	Lansdale loam, 15 to 25 percent slopes	93	IVe-1	16
LdB	Lansdale extremely stony loam, 0 to 8 percent slopes	93	VIIs-1	18
LdD	Lansdale extremely stony loam, 8 to 25 percent slopes	93	VIIs-1	18
LdE	Lansdale extremely stony loam, 25 to 50 percent slopes	93	VIIs-3	18
LgA	Lawrenceville silt loam, 0 to 3 percent slopes	94	IIw-2	15
LgB	Lawrenceville silt loam, 3 to 8 percent slopes	94	IIe-5	14
LhB	Lehigh channery silt loam, 2 to 8 percent slopes	95	IIIw-1	16
LhC	Lehigh channery silt loam, 8 to 18 percent slopes	95	IIIe-6	16
LlD	Lehigh extremely stony silt loam, 8 to 25 percent slopes	96	VIIs-2	18
MaB	Manor loam, 3 to 8 percent slopes	96	IIe-4	13
MaC	Manor loam, 8 to 15 percent slopes	96	IIIe-3	15
MaD	Manor loam, 15 to 25 percent slopes	96	IVe-2	16
MbD	Manor extremely stony loam, 8 to 25 percent slopes	97	VIIs-1	18
McE	Manor and Chester extremely stony loams, 25 ot 50 percent slopes	97	VIIs-3	18
Mh	Marsh	97	VIIIs-1	18
MlA	Mount Lucas silt loam, 0 to 3 percent slopes	98	IIw-2	15
MlB	Mount Lucas silt loam, 3 to 8 percent slopes	98	IIe-5	14
MlC	Mount Lucas silt loam, 8 to 15 percent slopes	98	IIIe-5	15
MoB	Mount Lucas extremely stony silt loam, 0 to 8 percent slopes	98	VIIs-2	18
MoD	Mount Lucas extremely stony silt loam, 8 to 25 percent slopes	98	VIIs-2	18
NeB	Neshaminy channery silt loam, 3 to 8 percent slopes	99	IIe-2	13
NeC	Neshaminy channery silt loam, 8 to 15 percent slopes	99	IIIe-1	15
NhB	Neshaminy extremely stony silt loam, 0 to 8 percent slopes	99	VIIs-1	18
NhD	Neshaminy extremely stony silt loam, 8 to 25 percent slopes	99	VIIs-1	18
NhE	Neshaminy extremely stony silt loam, 25 to 50 percent slopes	99	VIIs-3	18
PeA	Penn silt loam, 0 to 3 percent slopes	100	IIs-1	15
PeB	Penn silt loam, 3 to 8 percent slopes	100	IIe-4	13
PeC	Penn silt loam, 8 to 15 percent slopes	100	IIIe-3	15
PeD	Penn silt loam, 15 to 25 percent slopes	101	IVe-2	16
PhB3	Penn-Klinesville shaly silt loams, 3 to 8 percent slopes, eroded	101	IIIe-4	15
PkC3	Penn-Klinesville complex, 8 to 15 percent slopes, eroded	101	IVe-3	17
PlD	Penn-Klinesville extremely stony silt loams, 8 to 25 percent slopes	101	VIIs-1	18
PlE	Penn-Klinesville extremely stony silt loams, 25 to 50 percent slopes	101	VIIs-3	18
PnB	Peen-Lansdale complex, 3 to 8 percent slopes	101	IIe-4	13
PnC	Penn-Lansdale complex, 8 to 15 percent slopes	102	IIIe-3	15
PoA	Pope loam, 0 to 5 percent slopes	103	IIw-1	14
PpA	Pope loam, terrace, 0 to 3 percent slopes	103	I-1	12
PpB	Pope loam, terrace, 3 to 10 percent slopes	103	IIe-1	13
RdA	Readington silt loam, 0 to 3 percent slopes	104	IIw-2	15
RdB	Readington silt loam, 3 to 8 percent slopes	104	IIe-5	14
RdC	Readington silt loam, 8 to 15 percent slopes	104	IIIe-5	15
ReA	Reaville shaly silt loam, 0 to 3 percent slopes	105	IIIw-3	16
ReB	Reaville shaly silt loam, 3 to 8 percent slopes	105	IIIw-3	16
ReC	Reaville shaly silt loam, 8 to 15 percent slopes	105	IVe-4	17
Ro	Rowland silt loam	105	IIw-1	14
StB	Steinsburg gravelly loam, 3 to 8 percent slopes	106	IIe-4	13
StC	Steinsburg gravelly loam, 8 to 15 percent slopes	107	IIIe-3	15
StD	Steinsburg gravelly loam, 15 to 25 percent slopes	107	IVe-2	16
ToA	Towhee silt loam, 0 to 3 percent slopes	108	IVw-2	18
ToB	Towhee silt loam, 3 to 8 percent slopes	108	IVw-2	18
TwB	Towhee extremely stony silt loam, 0 to 8 percent slopes	108	VIIs-4	18
Ub	Urban land	108	Unassigned	--
Uc	Urban land-Abbottstown complex	108	Unassigned	--
UdB	Urban land-Chester complex, 0 to 8 percent slopes	108	Unassigned	--
UdC	Urban land-Chester complex, 8 to 15 percent slopes	109	Unassigned	--
Uh	Urban land-Howell complex	109	Unassigned	--
UlB	Urban land-Lansdale complex, 0 to 8 percent slopes	109	Unassigned	--
UlC	Urban land-Lansdale complex, 8 to 15 percent slopes	109	Unassigned	--
UrA	Urbana silt loam, 0 to 3 percent slopes	110	IIw-2	15
UrB	Urbana silt loam, 3 to 8 percent slopes	110	IIe-5	14
WaB	Washington gravelly silt loam, 3 to 8 percent slopes	110	IIe-2	13
WcD	Weikert-Culleoka shaly silt loams, 15 to 25 percent slopes	111	VIe-1	18
WoA	Woodstown silt loam, 0 to 5 percent slopes	111	IIw-2	15

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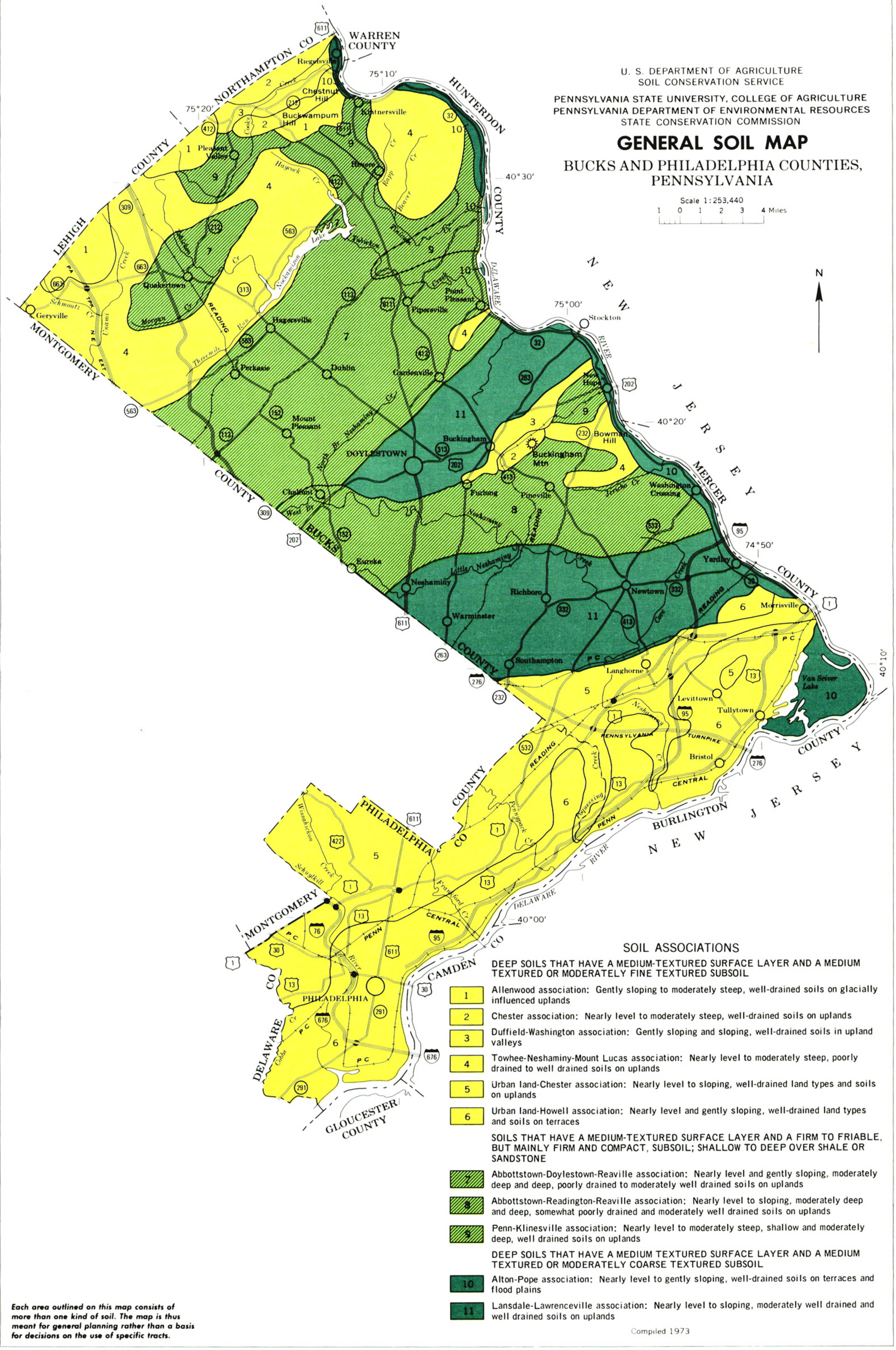


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PENNSYLVANIA STATE UNIVERSITY, COLLEGE OF AGRICULTURE
PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES
STATE CONSERVATION COMMISSION

GENERAL SOIL MAP

BUCKS AND PHILADELPHIA COUNTIES, PENNSYLVANIA

Scale 1:253,440

1 0 1 2 3 4 Miles

SOIL ASSOCIATIONS

DEEP SOILS THAT HAVE A MEDIUM-TEXTURED SURFACE LAYER AND A MEDIUM TEXTURED OR MODERATELY FINE TEXTURED SUBSOIL

1 Allenwood association: Gently sloping to moderately steep, well-drained soils on glacially influenced uplands

2 Chester association: Nearly level to moderately steep, well-drained soils on uplands

3 Duffield-Washington association: Gently sloping and sloping, well-drained soils in upland valleys

4 Towhee-Neshaminy-Mount Lucas association: Nearly level to moderately steep, poorly drained to well drained soils on uplands

5 Urban land-Chester association: Nearly level to sloping, well-drained land types and soils on uplands

6 Urban land-Howell association: Nearly level and gently sloping, well-drained land types and soils on terraces

SOILS THAT HAVE A MEDIUM-TEXTURED SURFACE LAYER AND A FIRM TO FRIABLE, BUT MAINLY FIRM AND COMPACT, SUBSOIL; SHALLOW TO DEEP OVER SHALE OR SANDSTONE

7 Abbottstown-Doylestown-Reaville association: Nearly level and gently sloping, moderately deep and deep, poorly drained to moderately well drained soils on uplands

8 Abbottstown-Readington-Reaville association: Nearly level to sloping, moderately deep and deep, somewhat poorly drained and moderately well drained soils on uplands

9 Penn-Klinesville association: Nearly level to moderately steep, shallow and moderately deep, well drained soils on uplands

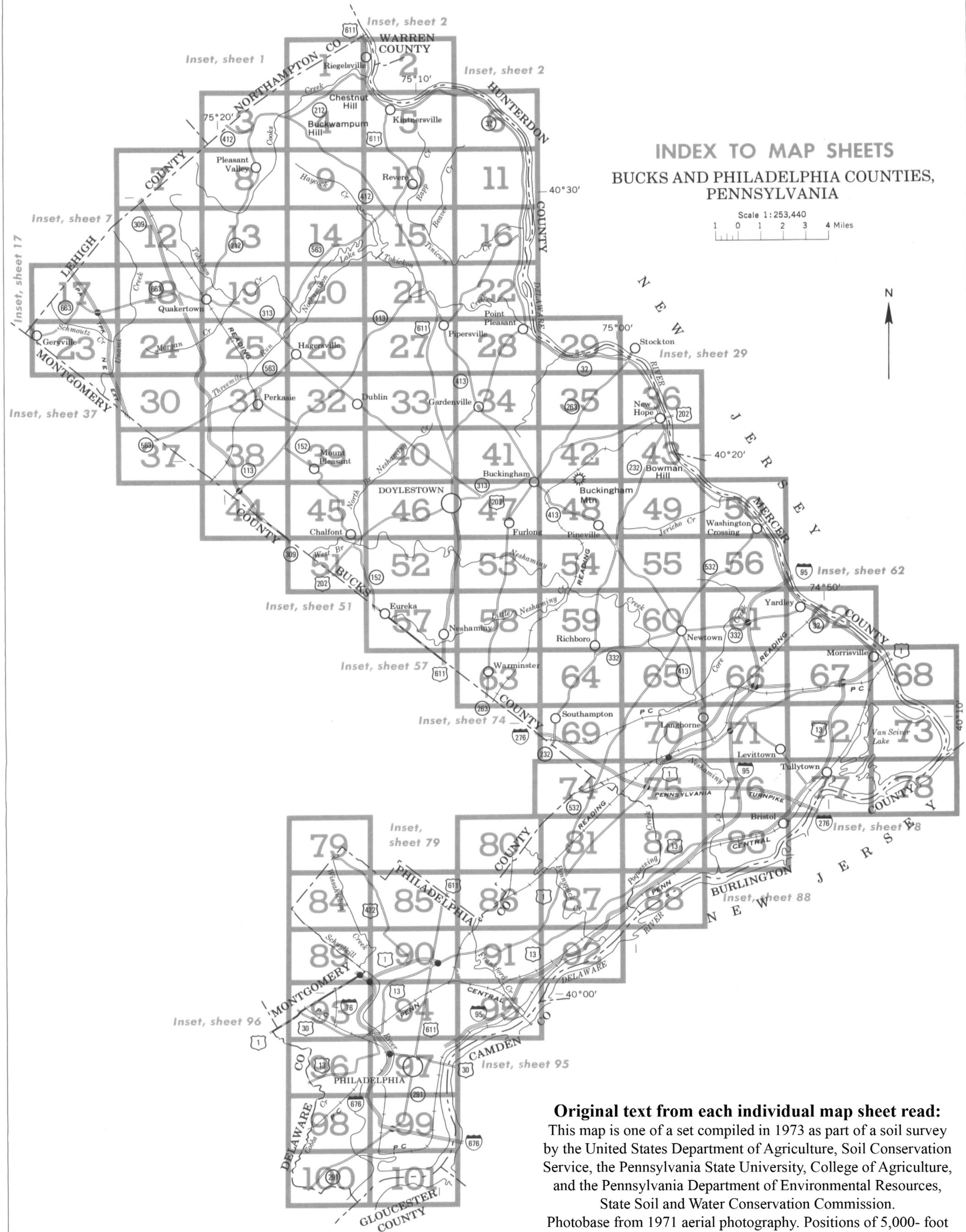
DEEP SOILS THAT HAVE A MEDIUM TEXTURED SURFACE LAYER AND A MEDIUM TEXTURED OR MODERATELY COARSE TEXTURED SUBSOIL

10 Alton-Pope association: Nearly level to gently sloping, well-drained soils on terraces and flood plains

11 Lansdale-Lawrenceville association: Nearly level to sloping, moderately well drained and well drained soils on uplands

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

Compiled 1973



Original text from each individual map sheet read:

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, the Pennsylvania State University, College of Agriculture, and the Pennsylvania Department of Environmental Resources, State Soil and Water Conservation Commission.

Photobase from 1971 aerial photography. Positions of 5,000- foot grid ticks are approximate and based on the Pennsylvania coordinate system, south zone.

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry — FY
- Ford — FORD
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches

Lakes and ponds
- Perennial — water, w
- Intermittent — int

Spring

Marsh or swamp

Wet spot

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

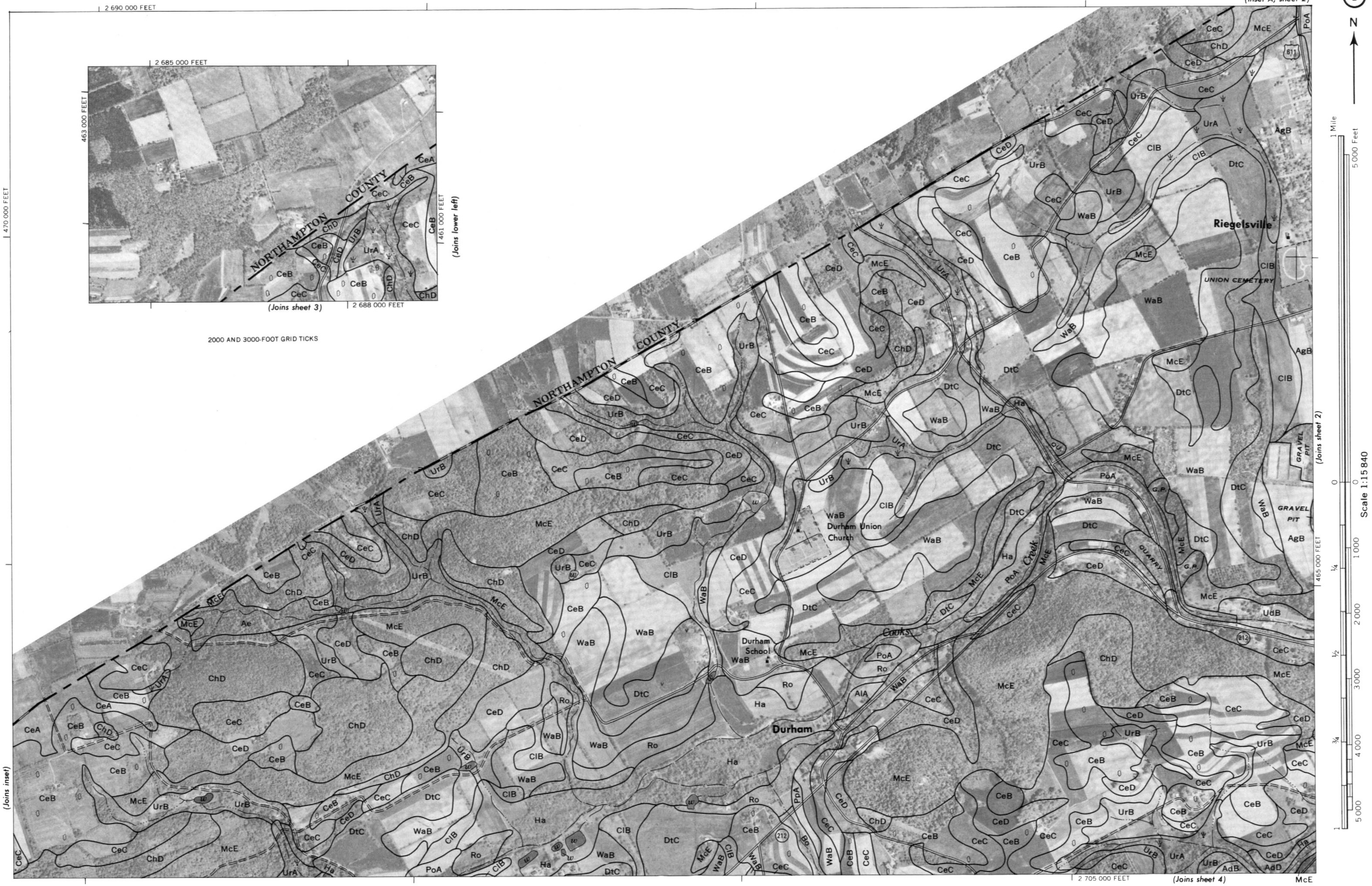
SOIL SURVEY DATA

- Soil boundary and symbol — Dx
- Gravel
- Stoniness
  - Stony
  - Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, or E, shows the slope. Most symbols without a slope letter are those of nearly level soils, but some are for soils and land types that have a considerable range of slope. A final number, 3, in a symbol shows that the soil is eroded.

SYMBOL	NAME
AbA	Abbottstown silt loam, 0 to 3 percent slopes
AbB	Abbottstown silt loam, 3 to 8 percent slopes
AbC	Abbottstown silt loam, 8 to 15 percent slopes
AdB	Allenwood gravelly silt loam, 3 to 8 percent slopes
AdC	Allenwood gravelly silt loam, 8 to 15 percent slopes
AdD	Allenwood gravelly silt loam, 15 to 25 percent slopes
Ae	Alluvial land
AgA	Alton gravelly loam, 0 to 3 percent slopes
AgB	Alton gravelly loam, 3 to 8 percent slopes
AlA	Alton gravelly loam, flooded, 0 to 5 percent slopes
BeA	Bedington silt loam, 0 to 3 percent slopes
BeB	Bedington silt loam, 3 to 8 percent slopes
BeC	Bedington silt loam, 8 to 15 percent slopes
Bo	Bowmansville silt loam
CaA	Chalfont silt loam, 0 to 3 percent slopes
CaB	Chalfont silt loam, 3 to 8 percent slopes
CeA	Chester silt loam, 0 to 3 percent slopes
CeB	Chester silt loam, 3 to 8 percent slopes
CeC	Chester silt loam, 8 to 15 percent slopes
CeD	Chester silt loam, 15 to 25 percent slopes
ChD	Chester extremely stony loam, 8 to 25 percent slopes
ClB	Clarksburg silt loam, 2 to 6 percent slopes
CwB	Culleoka-Weikert shaly silt loams, 3 to 8 percent slopes
CwC	Culleoka-Weikert shaly silt loams, 8 to 15 percent slopes
DoA	Doylestown silt loam, 0 to 3 percent slopes
DoB	Doylestown silt loam, 3 to 8 percent slopes
DsB	Duffield silt loam, 2 to 8 percent slopes
DtC	Duffield and Washington soils, 8 to 20 percent slopes
DuA	Duncannon silt loam, 0 to 3 percent slopes
DuB	Duncannon silt loam, 3 to 8 percent slopes
Fa	Fallsington silt loam, gravelly subsoil variant
Ha	Hatboro silt loam
HoA	Howell silt loam, 0 to 3 percent slopes
HoB	Howell silt loam, 3 to 8 percent slopes
KlB	Klinesville very shaly silt loam, 3 to 8 percent slopes
KlC	Klinesville very shaly silt loam, 8 to 15 percent slopes
KlD	Klinesville very shaly silt loam, 15 to 25 percent slopes
LaA	Lansdale loam, 0 to 3 percent slopes
LaB	Lansdale loam, 3 to 8 percent slopes
LaC	Lansdale loam, 8 to 15 percent slopes
LaD	Lansdale loam, 15 to 25 percent slopes
LdB	Lansdale extremely stony loam, 0 to 8 percent slopes
LdD	Lansdale extremely stony loam, 8 to 25 percent slopes
LdE	Lansdale extremely stony loam, 25 to 50 percent slopes
LgA	Lawrenceville silt loam, 0 to 3 percent slopes
LgB	Lawrenceville silt loam, 3 to 8 percent slopes
LhB	Lehigh channery silt loam, 2 to 8 percent slopes
LhC	Lehigh channery silt loam, 8 to 18 percent slopes
LlD	Lehigh extremely stony silt loam, 8 to 25 percent slopes
MaB	Manor loam, 3 to 8 percent slopes
MaC	Manor loam, 8 to 15 percent slopes
MaD	Manor loam, 15 to 25 percent slopes
MbD	Manor extremely stony loam, 8 to 25 percent slopes
McE	Manor and Chester extremely stony loams, 25 to 50 percent slopes
Mh	Marsh
MlA	Mount Lucas silt loam, 0 to 3 percent slopes
MlB	Mount Lucas silt loam, 3 to 8 percent slopes
MlC	Mount Lucas silt loam, 8 to 15 percent slopes
MoB	Mount Lucas extremely stony silt loam, 0 to 8 percent slopes
MoD	Mount Lucas extremely stony silt loam, 8 to 25 percent slopes
NeB	Neshaminy channery silt loam, 3 to 8 percent slopes
NeC	Neshaminy channery silt loam, 8 to 15 percent slopes
NhB	Neshaminy extremely stony silt loam, 0 to 8 percent slopes
NhD	Neshaminy extremely stony silt loam, 8 to 25 percent slopes
NhE	Neshaminy extremely stony silt loam, 25 to 50 percent slopes
PeA	Penn silt loam, 0 to 3 percent slopes
PeB	Penn silt loam, 3 to 8 percent slopes
PeC	Penn silt loam, 8 to 15 percent slopes
PeD	Penn silt loam, 15 to 25 percent slopes
PhB3	Penn-Klinesville shaly silt loams, 3 to 8 percent slopes, eroded
PkC3	Penn-Klinesville complex, 8 to 15 percent slopes, eroded
PlD	Penn-Klinesville extremely stony silt loams, 8 to 25 percent slopes
PlE	Penn-Klinesville extremely stony silt loams, 25 to 50 percent slopes
PnB	Penn-Lansdale complex, 3 to 8 percent slopes
PnC	Penn-Lansdale complex, 8 to 15 percent slopes
PoA	Pope loam, 0 to 5 percent slopes
PpA	Pope loam, terrace, 0 to 3 percent slopes
PpB	Pope loam, terrace, 3 to 10 percent slopes
RdA	Readington silt loam, 0 to 3 percent slopes
RdB	Readington silt loam, 3 to 8 percent slopes
RdC	Readington silt loam, 8 to 15 percent slopes
ReA	Reaville shaly silt loam, 0 to 3 percent slopes
ReB	Reaville shaly silt loam, 3 to 8 percent slopes
ReC	Reaville shaly silt loam, 8 to 15 percent slopes
Ro	Rowland silt loam
StB	Steinsburg gravelly loam, 3 to 8 percent slopes
StC	Steinsburg gravelly loam, 8 to 15 percent slopes
StD	Steinsburg gravelly loam, 15 to 25 percent slopes
ToA	Towhee silt loam, 0 to 3 percent slopes
ToB	Towhee silt loam, 3 to 8 percent slopes
TwB	Towhee extremely stony silt loam, 0 to 8 percent slopes
Ub	Urban land
Uc	Urban land-Abbottstown complex
UdB	Urban land-Chester complex, 0 to 8 percent slopes
UdC	Urban land-Chester complex, 8 to 15 percent slopes
Uh	Urban land-Howell complex
UlB	Urban land-Lansdale complex, 0 to 8 percent slopes
UlC	Urban land-Lansdale complex, 8 to 15 percent slopes
UrA	Urbana silt loam, 0 to 3 percent slopes
UrB	Urbana silt loam, 3 to 8 percent slopes
WaB	Washington gravelly silt loam, 3 to 8 percent slopes
WcD	Weikert-Culleoka shaly silt loams, 15 to 25 percent slopes
WoA	Woodstown silt loam, 0 to 5 percent slopes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UNION CEMETERY
GRAVEL PIT
GRAVEL PIT
QUARRY
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465 000 FEET
Durham Union Church
Durham School
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Cooks Creek
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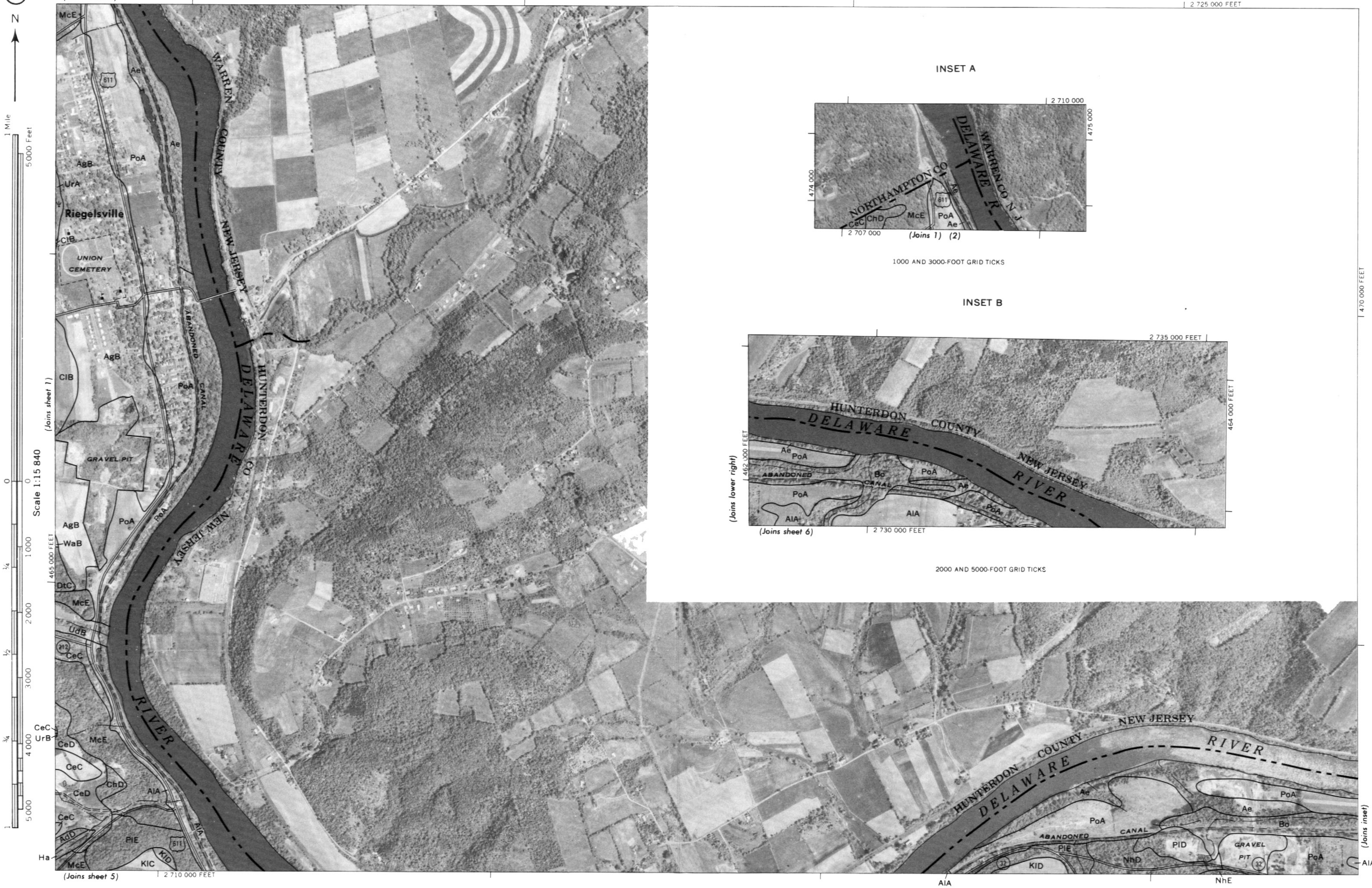
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HUNTERDON CO NEW JERSEY
DELAWARE RIVER
HUNTERDON COUNTY NEW JERSEY
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Ae
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WaB
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HUNTERDON COUNTY NEW JERSEY
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2000 AND 5000-FOOT GRID TICKS
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Springtown
Salem Church
Bitts Hill
Cooks Creek
NORTHAMPTON COUNTY
LEHIGH CO
Scale 1:15 840
1 Mile
5 000 Feet

BUCKS AND PHILADELPHIA COUNTIES, PENNSYLVANIA — SHEET NUMBER 4


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DELAWARE RIVER
GRAVEL PIT
Lynn Island
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Kintnersville
Gallows Run
Coffman Hill
Lake Warren
Beaver Creek
1 Mile
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1 Mile
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Upper
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GRAVEL PIT
GRAVEL PIT
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NEW JERSEY
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LEHIGH COUNTY
Steinsburg
Springfield Church
Tumble Brook
(Joins sheet 8)
The Lookout
QUARRY
READING
309
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2 670 000 FEET
(Joins sheet 12)
Scale 1:15 840
1 Mile
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(Joins sheet 13)
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445 000 FEET
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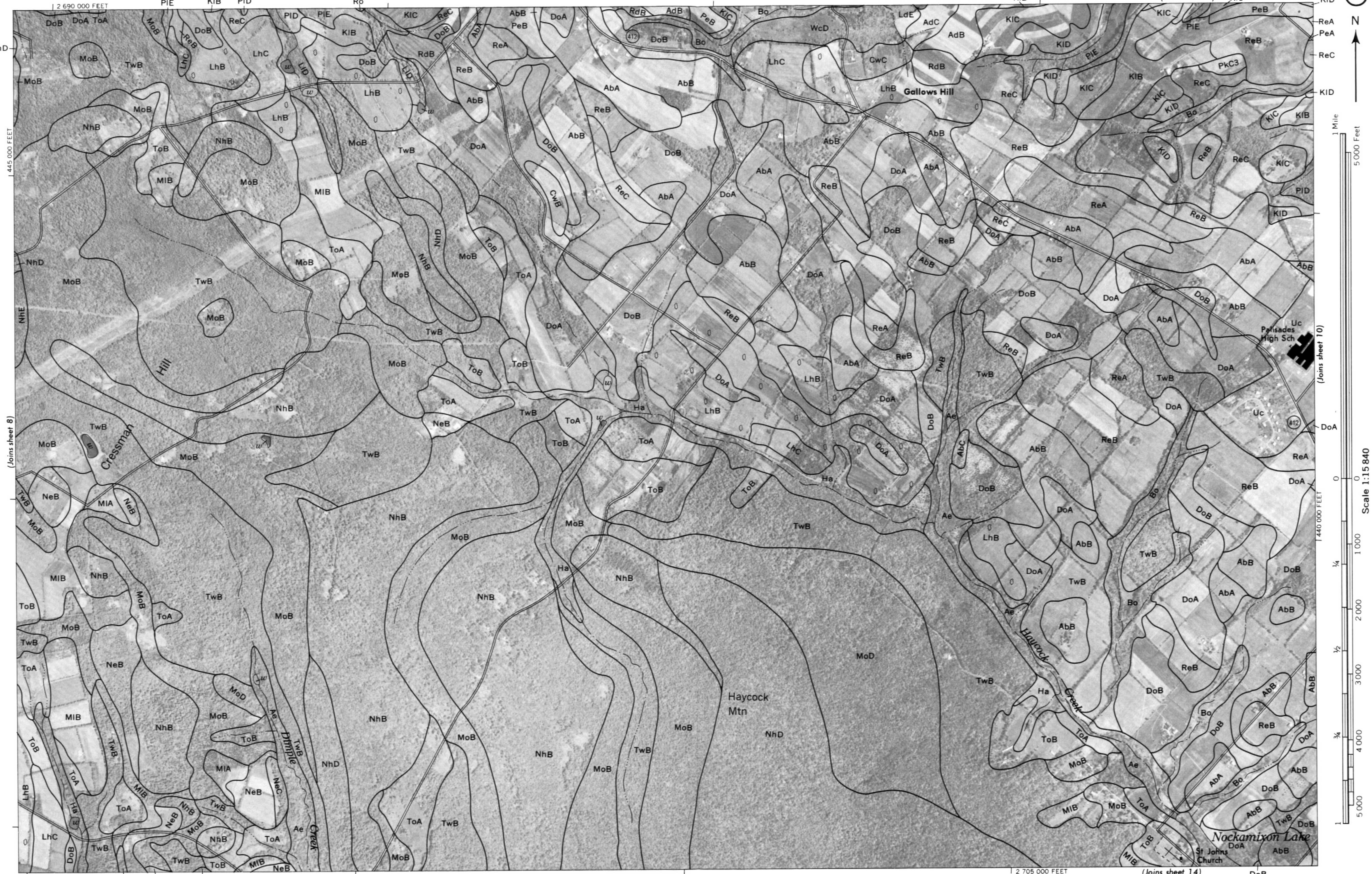
Springfield Church
Township School
Pleasant Valley
Passer
Amity
Cooks Creek
Molasses Hill


9
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445 000 FEET
440 000 FEET
Gallows Hill
Cressman Hill
Palisades High Sch
Haycock Mtn
Haycock Creek
Dimple Creek
Nockamixon Lake
St Johns Church
412
1 Mile
5 000 Feet
Scale 1:15 840

BUCKS AND PHILADELPHIA COUNTIES, PENNSYLVANIA — SHEET NUMBER 10


11
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Upper Tinicum Church
Uhlerstown
Erwinna
ABANDONED
PENNSYLVANIA
CANAL
DELAWARE
RIVER
HUNTERDON
COUNTY
NEW
JERSEY
32
1 Mile
5 000 Feet
Scale 1:15 840
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4000
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LEHIGH COUNTY
Zionhill
Shelly
California
Rosedale
Swamp Church
Unami
Creek
Tohickon Creek
READING
309
430 000 FEET
425 000 FEET
2 655 000 FEET
(Joins inset, sheet 7)
(Joins sheet 13)
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Scale 1:15 840
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13
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2 675 000 FEET
(Joins sheet 8)
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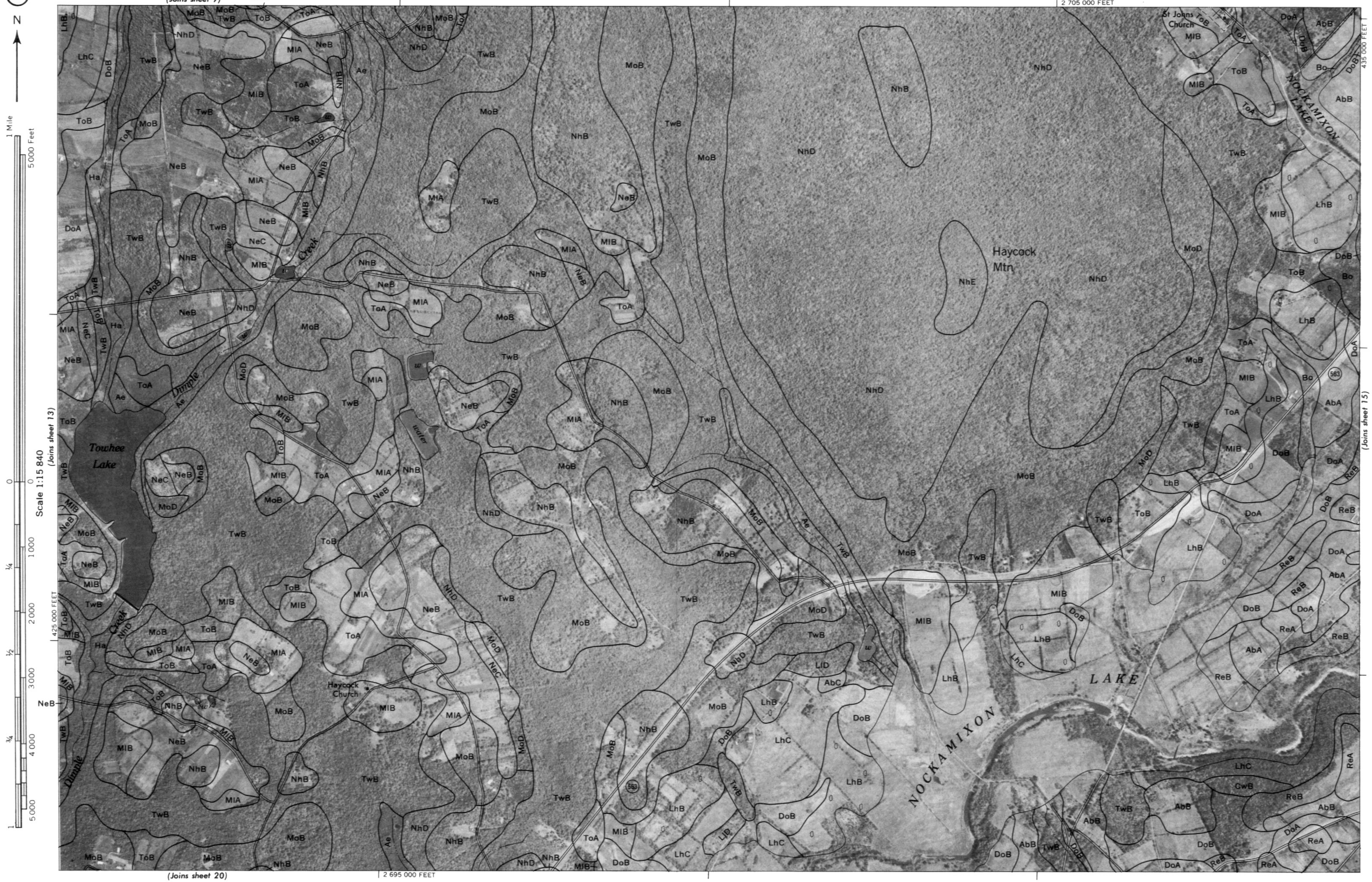
(Joins sheet 12)
(Joins sheet 14)
425 000 FEET
(Joins sheet 19)
2 690 000 FEET
Cooks
Creek
Applebachsville
Haycock School
Towhee Lake
St Pauls Church
Richlandtown
Dimple Cr
1 Mile
5 000 Feet
Scale 1:15 840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5000 Feet
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2 695 000 FEET
435 000 FEET
425 000 FEET
Towhee Lake
Dimple Creek
Haycock Mtn
Haycock Church
St Johns Church
NOCKAMIXON LAKE
water
563


2 710 000 FEET
435 000 FEET
(Joins sheet 10)
(Joins sheet 14)
(Joins sheet 16)
(Joins sheet 21)
2 725 000 FEET
425 000 FEET
Harrow
QUARRY
Rapp Creek
Beaver Creek
Tinicum Creek
NOCKAMIXON LAKE
BORROW PIT
Ottsville
563
412
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Scale 1:15 840
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(Joins sheet 22)
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Scale 1:15 840
1 Mile
5000 Feet
2 745 000 FEET
435 000 FEET
425 000 FEET
2 730 000 FEET
Sundale
Tinicum
Creek
Marshall
Island
Treasure
Island
DELAWARE
RIVER
HUNTERDON COUNTY
N.J.
PENNSYLVANIA
CANAL


17
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(Joins sheet 18)
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410 000 FEET
2 630 000 FEET
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402 000 FEET
LEHIGH COUNTY
MONTGOMERY CO
2000 AND 3000-FOOT GRID TICKS
PENNSYLVANIA TURNPIKE
INTERCHANGE 32
CUT AND FILL LAND
Spinnerstown
Milford Sch
St Johns Church
West Swamp Church
Licking Creek
Molasses Creek
Schmoutz Creek
663
1 Mile
5000 Feet
Scale 1:15 840


(Joins sheet 12)
(Joins sheet 17)
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(Joins sheet 24)
N
Scale 1:15 840
1 Mile
5000 Feet
2 670 000 FEET
420 000 FEET
410 000 FEET
2 655 000 FEET
Brick Tavern
East Swamp Church
Tohickon Valley School
UNION CEM
QUAKERTOWN
Milford Square
Tohickon Creek
Licking Creek
Unami Creek
Beaver Run
READING
309
663


19
N
(Joins sheet 13)
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(Joins sheet 20)
(Joins sheet 25)
2 675 000 FEET
2 690 000 FEET
420 000 FEET
410 000 FEET
QUAKERTOWN
TOHICKON CREEK
TOHICKON CREEK
Dimple Creek
Morgan Creek
Beaver Run
READING
QUARRY
water
1 Mile
5 000 Feet
Scale 1:15 840


(Joins sheet 14)
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5000 Feet
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2 705 000 FEET
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410 000 FEET
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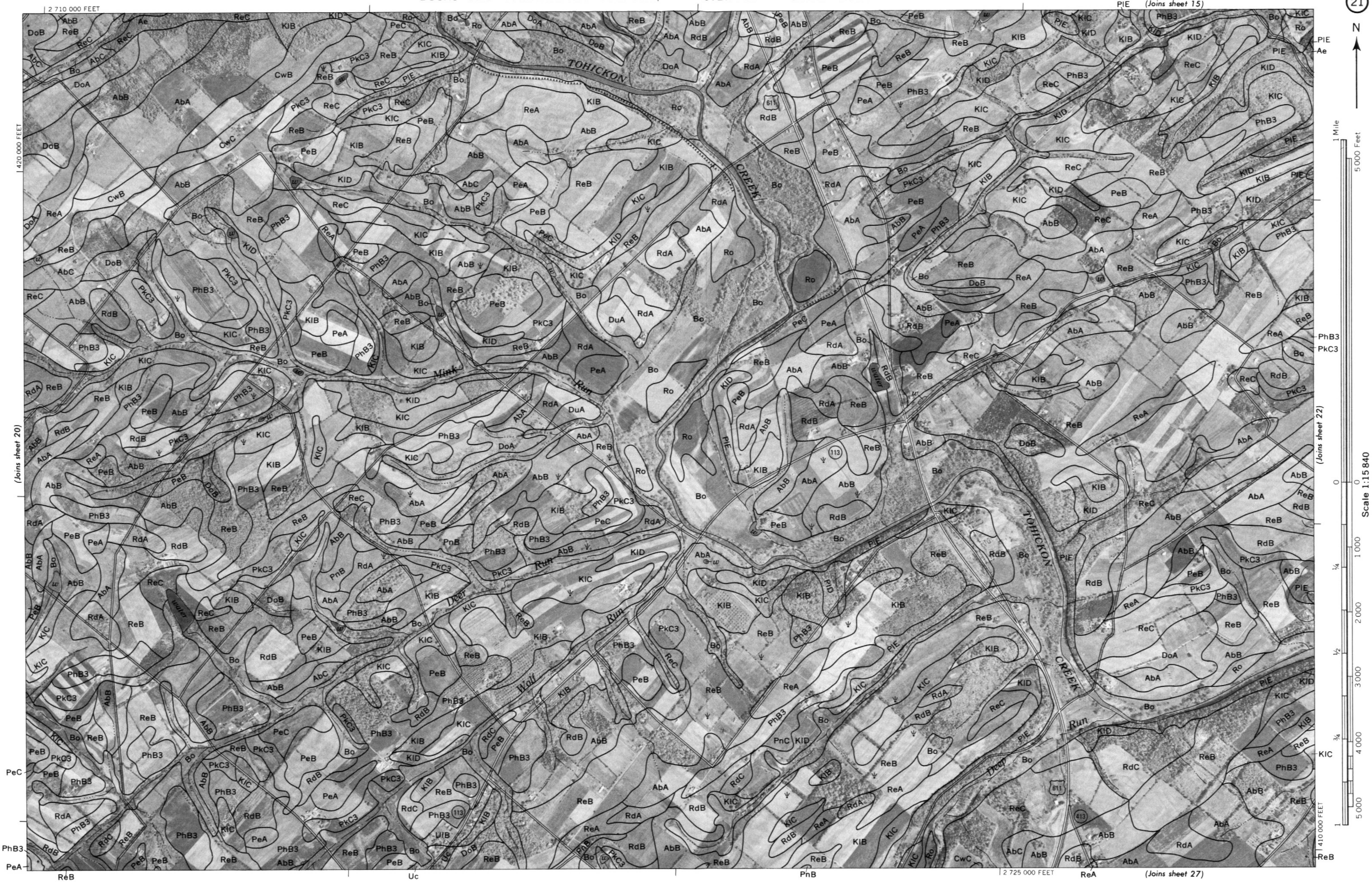
LAKE
NOCKAMIXON
Kellers Church
QUARRY
563


21
N
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PIE (Joins sheet 15)
(Joins sheet 20)
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2 725 000 FEET
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TOHICKON CREEK
Mink Run
Deer Run
Wolf Run
Deep Run
1 Mile
5000 Feet
Scale 1:15 840
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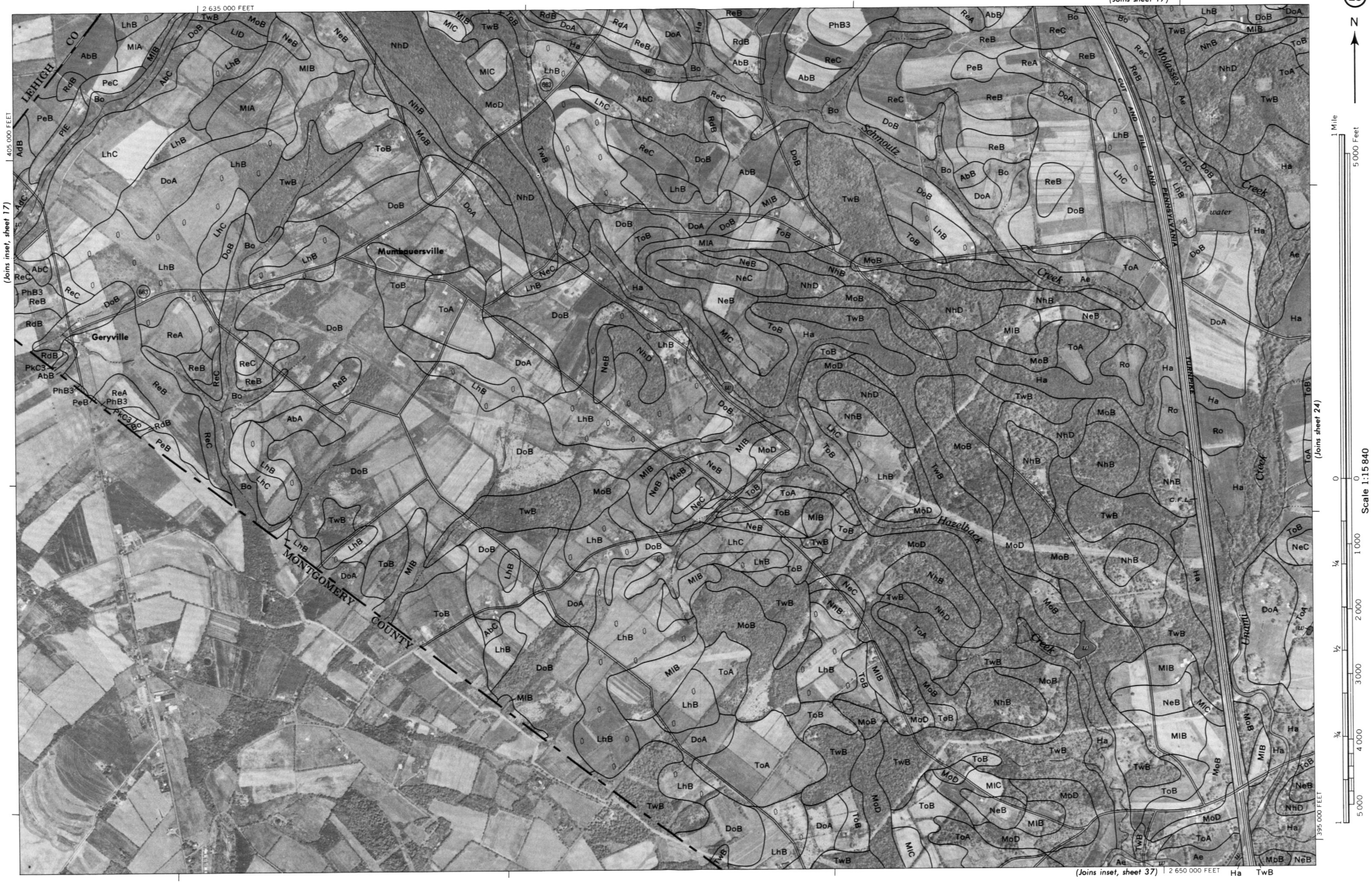
611
113
413


(Joins sheet 16)
(Joins sheet 21)
(Joins sheet 28)
N
1 Mile
5000 Feet
Scale 1:15 840
2 745 000 FEET
420 000 FEET
410 000 FEET
2 730 000 FEET
HILLPOT CEMETERY
Tinicum
TOHICKON
CREEK
Cabin
Run
DELAWARE
RIVER
PENNSYLVANIA
CANAL
HUNTERDON
COUNTY
NEW JERSEY
32


23
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(Joins inset, sheet 37)
2 635 000 FEET
405 000 FEET
2 650 000 FEET
395 000 FEET
LEHIGH CO
MONTGOMERY COUNTY
Mumbauersville
Geryville
Schmoutz Creek
Molasses Creek
Hazelback Creek
Unami Creek
PENNSYLVANIA TURNPIKE
CUT AND FILL LAND
water
C.F.L.
663
Scale 1:15 840
1 Mile
5 000 Feet
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1
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(Joins sheet 18)
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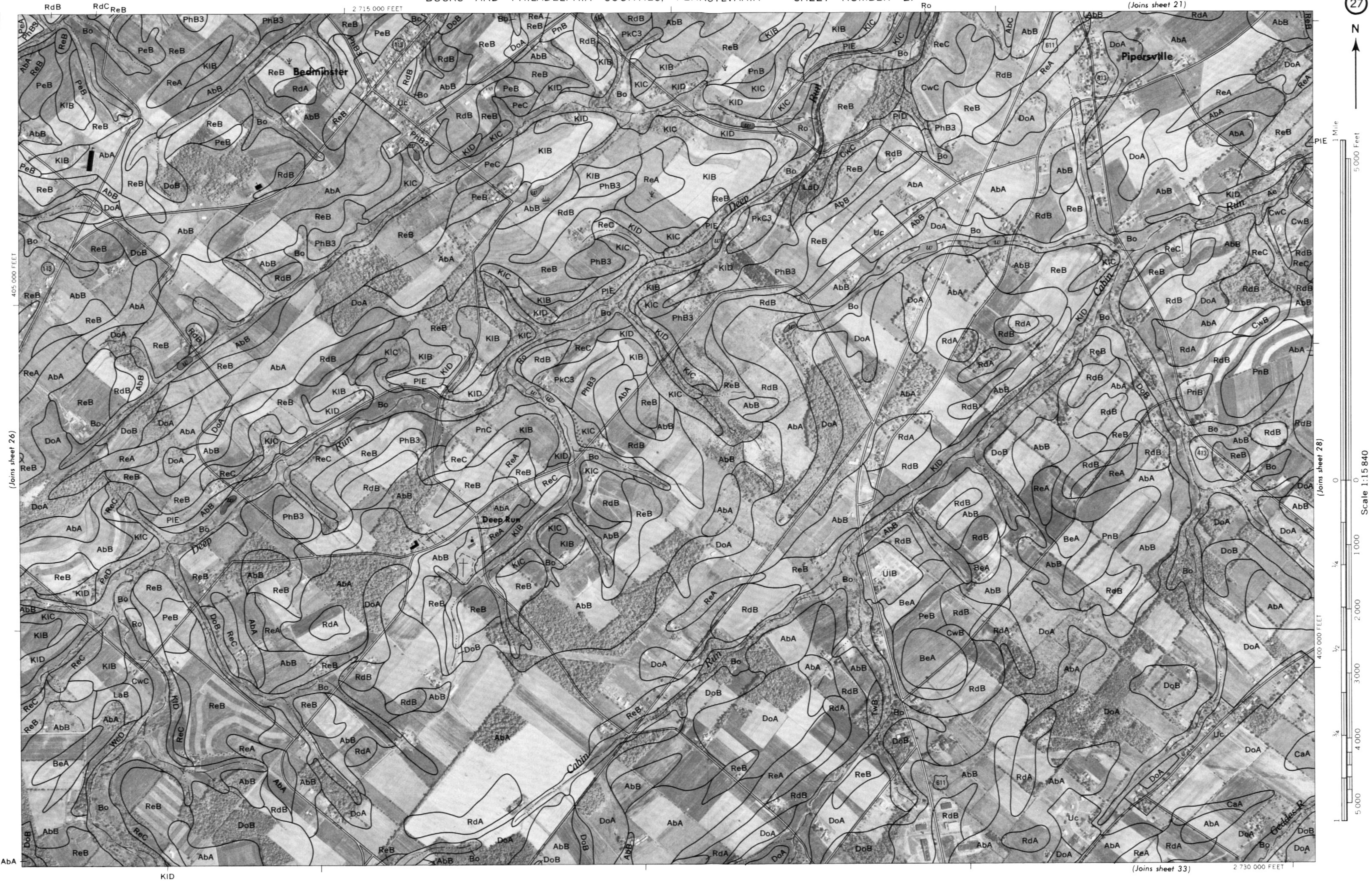
2 670 000 FEET
2 655 000 FEET
405 000 FEET
395 000 FEET
N
Scale 1:15 840
1 Mile
5000 Feet
Trumbauersville
Unami
Creek
Beaver
Run
Morgan
Creek
Butter
Creek
water
309


25
N
(Joins sheet 19)
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 31)
2 675 000 FEET
2 690 000 FEET
405 000 FEET
400 000 FEET
Scale 1:15 840
1 Mile
5 000 Feet
Paletown
Rich Hill
Smoketown
Rocky Ridge
Nockamixon Lake
QUARRY
East Rock Hill School
Morgan Creek
Threemile Run
READING

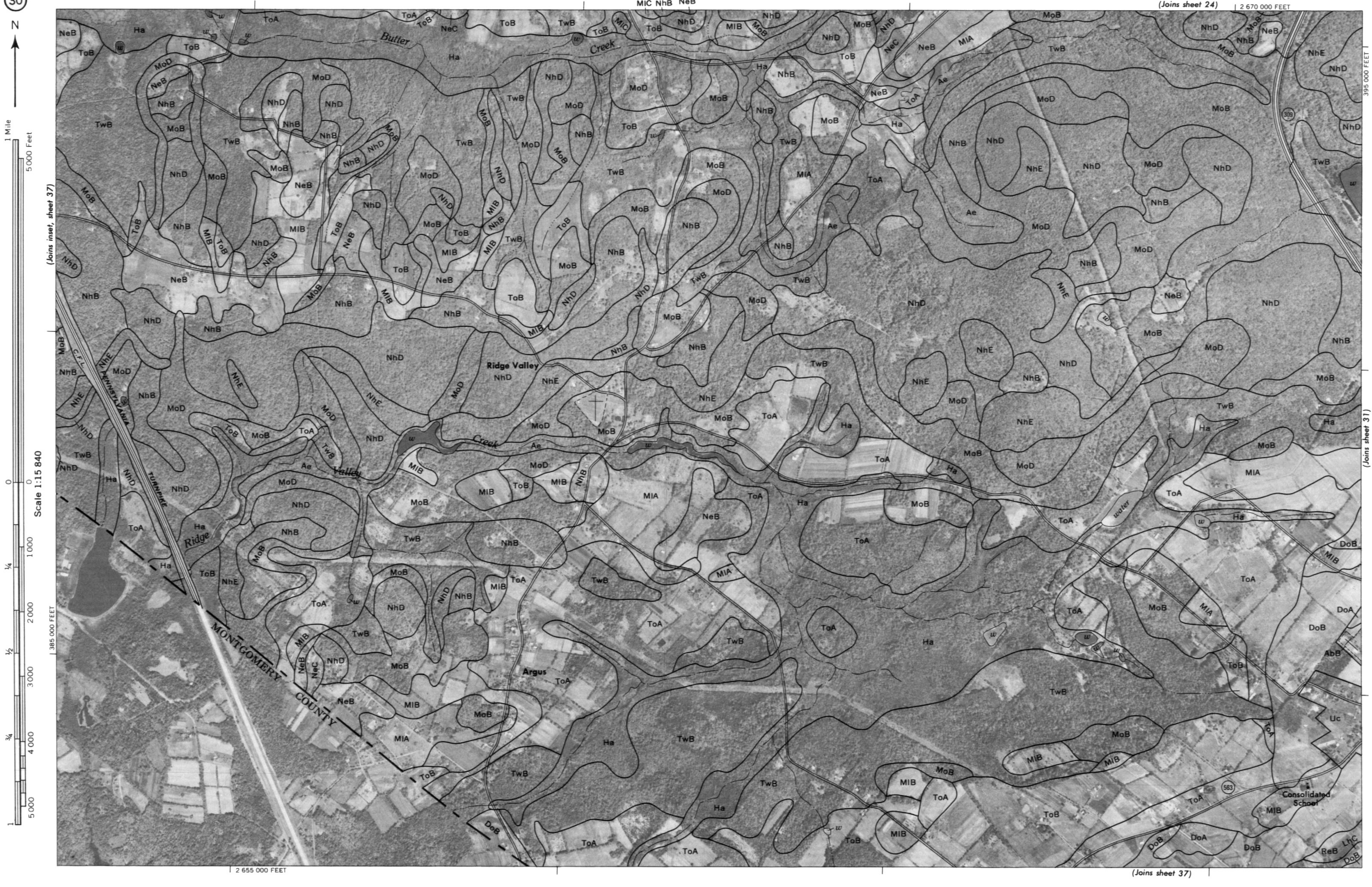

N
(Joins sheet 20)
(Joins sheet 25)
(Joins sheet 27)
(Joins sheet 32)
NOCKAMIXON LAKE
Elephant
Keelersville
Hagersville
Irish Meeting House
East Branch Perkiomen Creek
Morris Run
2 710 000 FEET
405 000 FEET
400 000 FEET
2 695 000 FEET
Scale 1:15 840
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
¼
½
¾
1

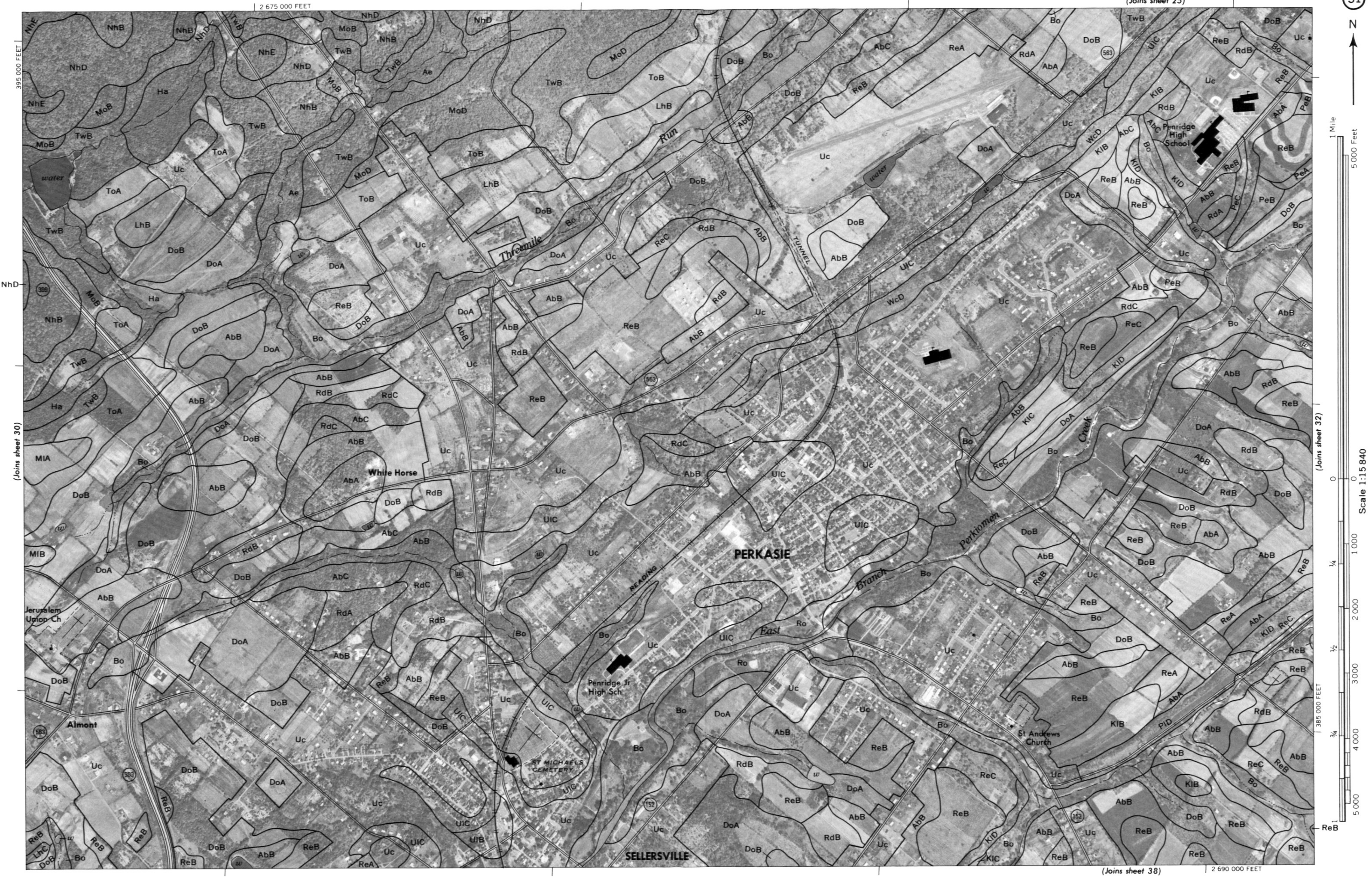

27
N
(Joins sheet 21)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 33)
2 715 000 FEET
2 730 000 FEET
405 000 FEET
400 000 FEET
Bedminster
Pipersville
Deep Run
Deep Run
Cabin Run
Geddes R
Scale 1:15 840
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
¼
½
¾
1

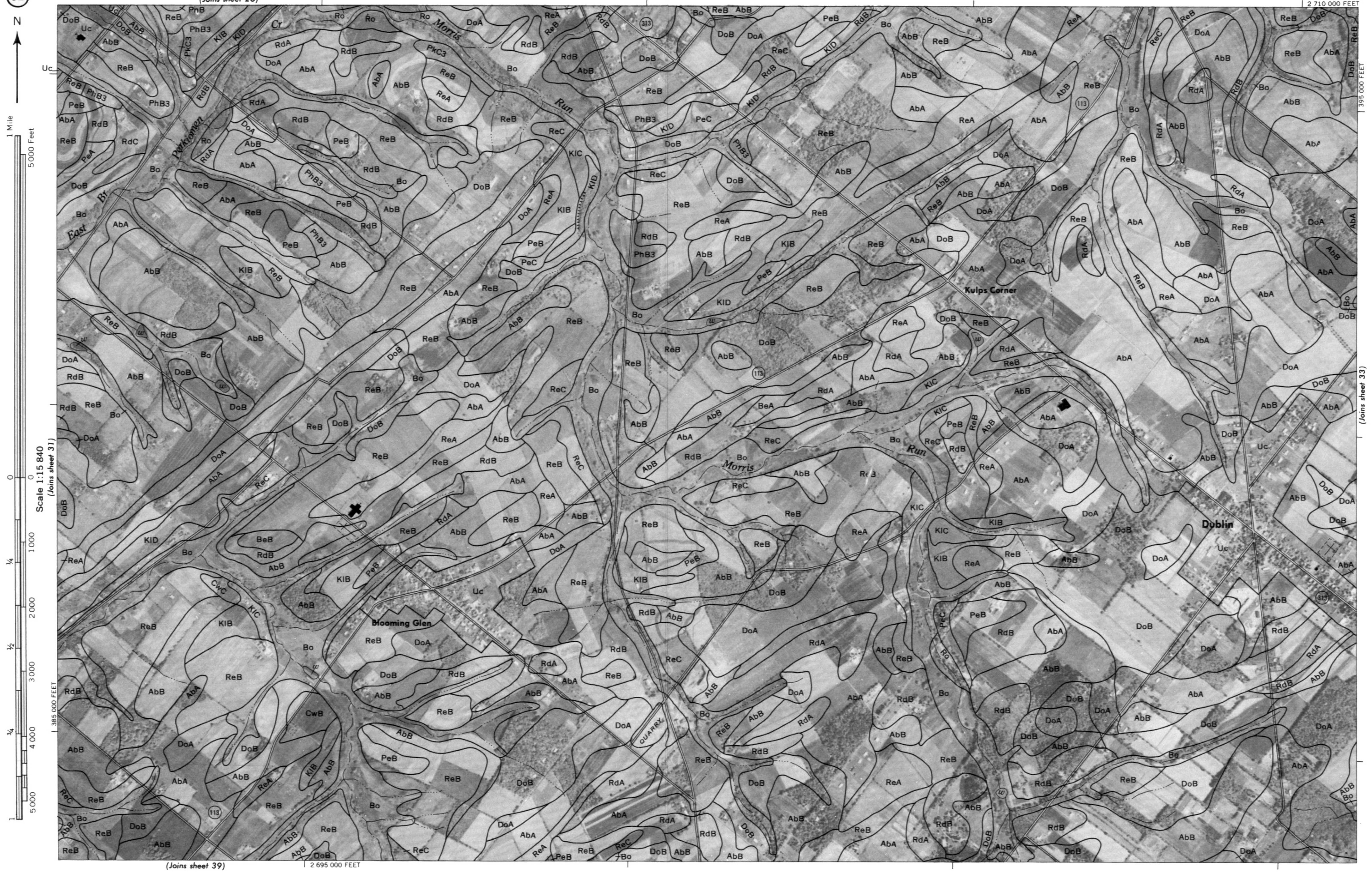

(Joins sheet 22)
(Joins sheet 27)
(Joins sheet 29)
(Joins sheet 34)
N
1 Mile
5 000 Feet
Scale 1:15 840
2 745 000 FEET
410 000 FEET
400 000 FEET
2 730 000 FEET
Smiths Corner
Point Pleasant
Wismer
Hinkletown
QUARRY
Cabin Run
Geddes Run
Hickory Creek
TOHICKON CREEK
PENNSYLVANIA CANAL
TUNNEL
DELAWARE RIVER
HUNTERDON COUNTY N.J.
32
413

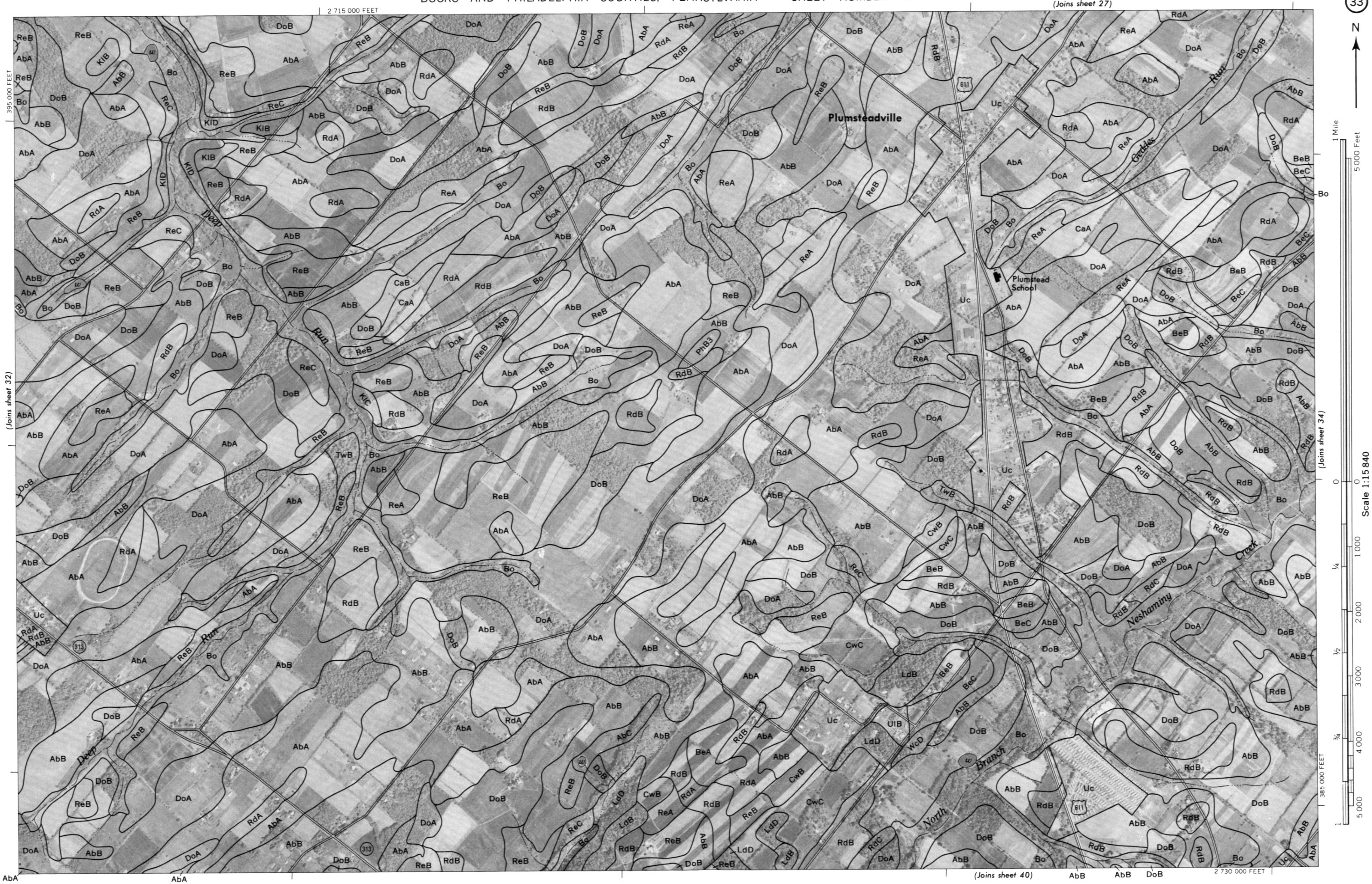
29
N
2 750 000 FEET
410 000 FEET
2 770 000 FEET
403 000 FEET
400 000 FEET
2 775 000 FEET
2 765 000 FEET
(Joins lower right)
(Joins sheet 36)
(Joins sheet 28)
(Joins sheet 35)
(Joins inset)
3000 AND 5000-FOOT GRID TICKS
DELAWARE RIVER
HUNTERDON COUNTY NEW JERSEY
PENNSYLVANIA CANAL
Center Bridge
Lumberville
Hendrick Island
Paunnacussing Creek
1 Mile
5 000 Feet
Scale 1:15 840

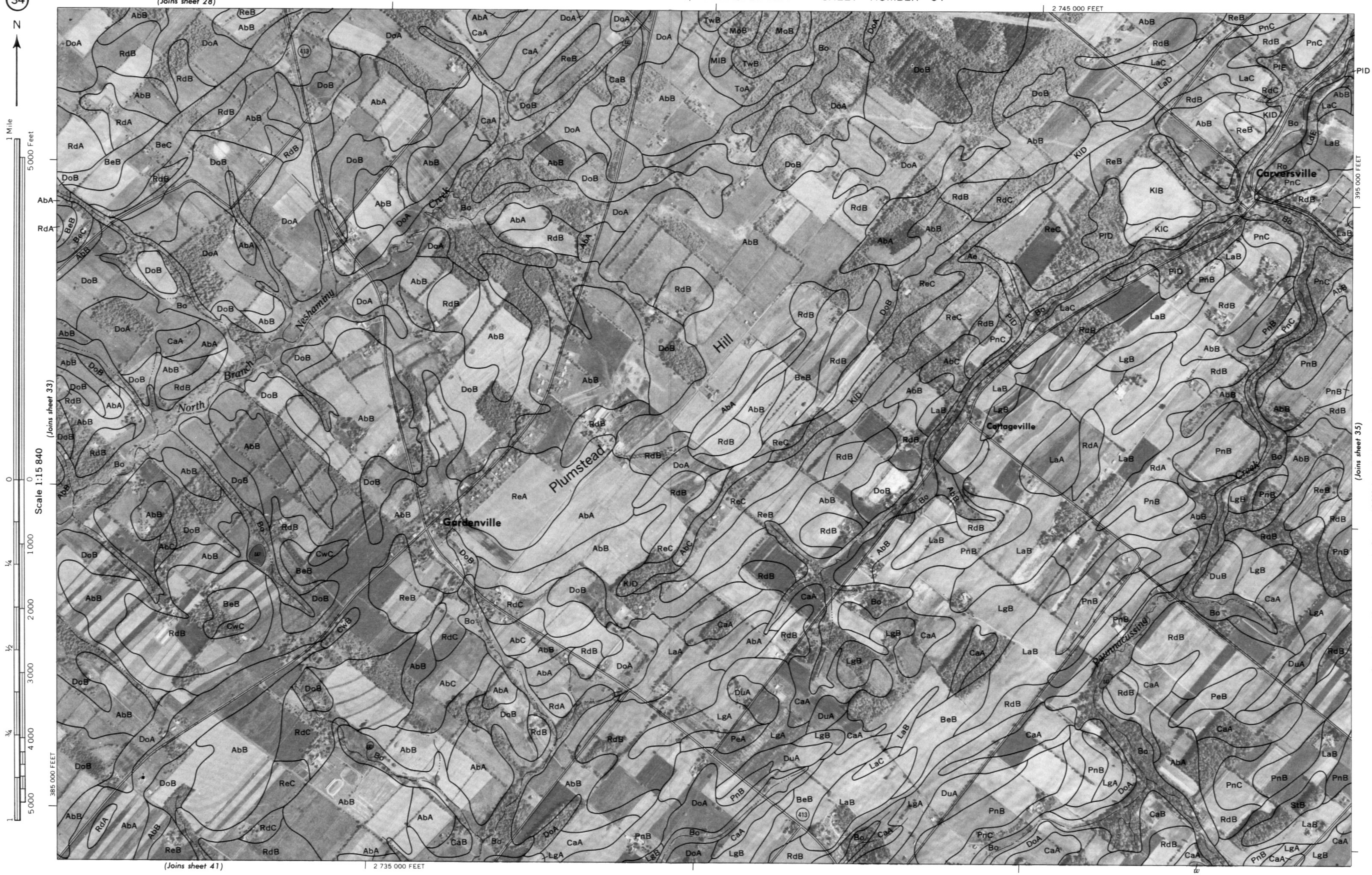
BUCKS AND PHILADELPHIA COUNTIES, PENNSYLVANIA — SHEET NUMBER 30




31
N
(Joins sheet 25)
(Joins sheet 30)
(Joins sheet 32)
(Joins sheet 38)
2 675 000 FEET
2 690 000 FEET
395 000 FEET
385 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
PERKASIE
SELLERSVILLE
White Horse
Almont
Jerusalem Union Ch
Penridge High School
Penridge Jr High Sch
St Andrews Church
ST MICHAELS CEMETERY
Threemile Run
East Branch Perkiomen Creek
READING
TUNNEL
water


(Joins sheet 26)
(Joins sheet 31)
(Joins sheet 33)
(Joins sheet 39)
N
Scale 1:15 840
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
¼
½
¾
1
2 710 000 FEET
395 000 FEET
385 000 FEET
2 695 000 FEET
Morris Run
Perkiomen Cr
East Br
Kulps Corner
Blooming Glen
Dublin
QUARRY
313
113


33
N
2 715 000 FEET
(Joins sheet 27)
395 000 FEET
(Joins sheet 32)
(Joins sheet 34)
(Joins sheet 40)
385 000 FEET
2 730 000 FEET
Plumsteadville
Plumstead School
Deep Run
Geddes Run
Neshaminy Creek
North Branch
611
313
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1

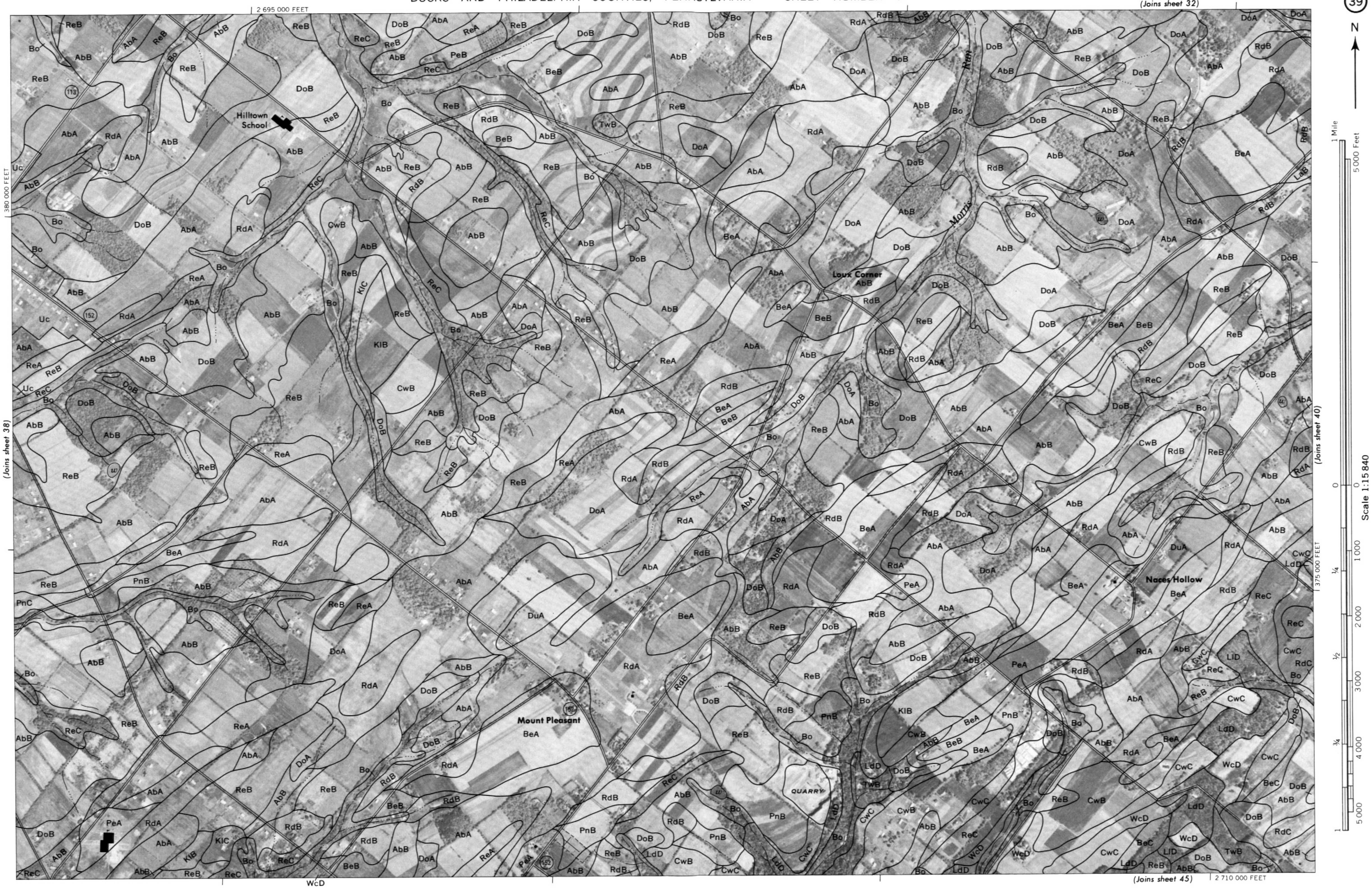

34
N
(Joins sheet 28)
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 41)
2 745 000 FEET
2 735 000 FEET
395 000 FEET
385 000 FEET
1 Mile
5000 Feet
Scale 1:15 840
Carversville
Cottageville
Gardenville
Plumstead
Hill
North
Branch
Neshaminy
Creek
Paunnacussing
413

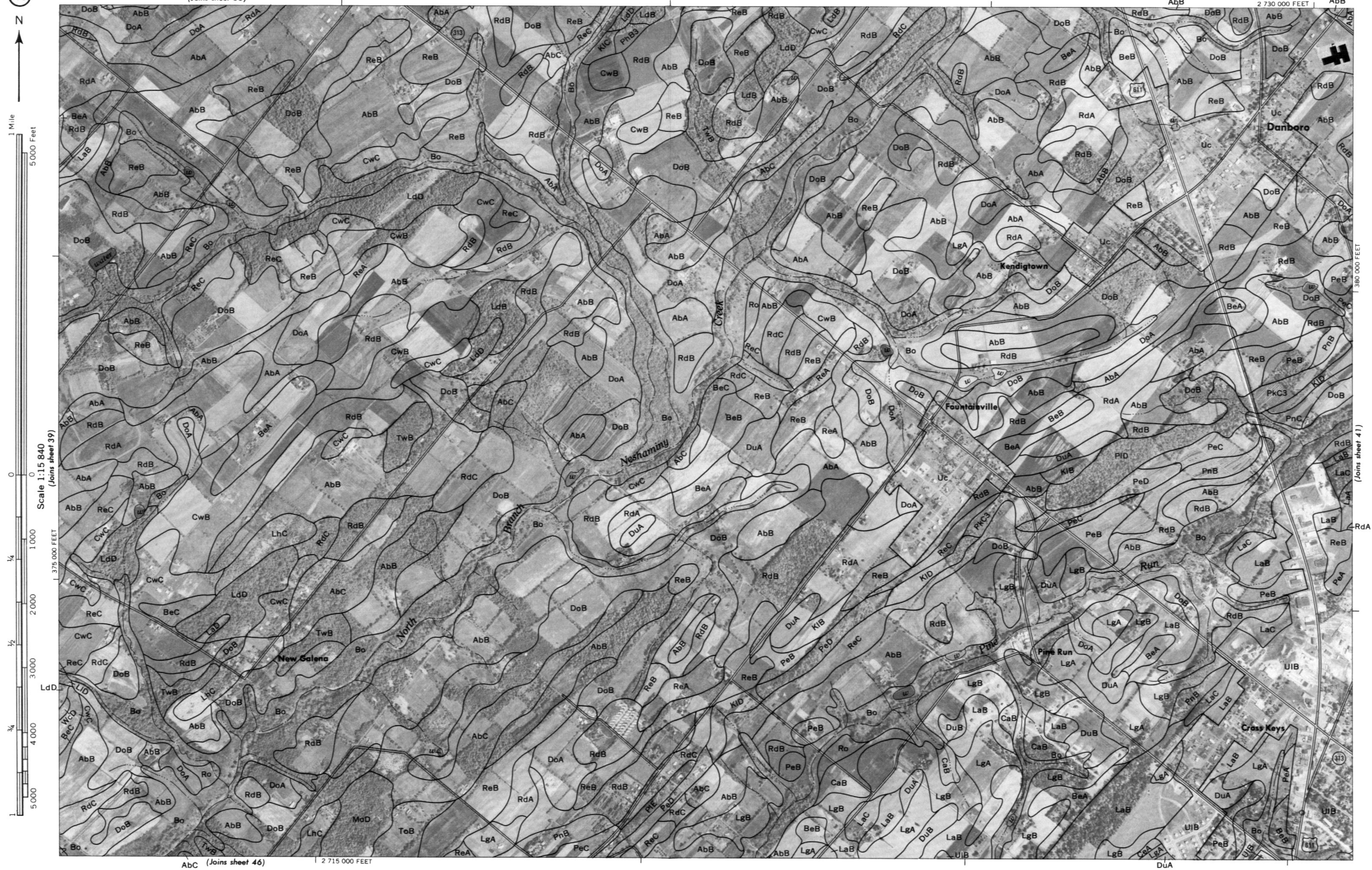

35
N
(Joins sheet 29)
(Joins sheet 34)
(Joins sheet 36)
(Joins sheet 42)
2 750 000 FEET
2 765 000 FEET
395 000 FEET
390 000 FEET
Solebury
263
1 Mile
5 000 Feet
Scale 1:15 840


(Joins inset, sheet 29)
2 785 000 FEET
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
(Joins sheet 35)
390 000 FEET
395 000 FEET
2 770 000 FEET
(Joins sheet 43)
DELAWARE
RIVER
HUNTERDON
COUNTY
NEW JERSEY
PENNSYLVANIA
CANAL
QUARRY
Solebury School
SOLEBURY CEMETERY
GRAVEL PIT
New Hope
Aquetong
Creek
READING
water
32
202
LdD
LdE
UlC
UlB
StC
LaB
LaC
LaD
RdC
RdB
RdA
PlD
PoA
Ae
AlA
Bo
WcD
DtC
CwC
CwB
BeA
DsB
KlD
KlC
KlB
PeB
PeC
PeA
PeD
PpA
PpB
AbB
MlB
ClB
DoA
LgA
Ha
CaB
McE
ReB
ReC
PlE
AbA
DuB
DoB
PnB
LgA
RdB


37
N
(Joins sheet 30)
(Joins sheet 23)
(Joins sheet 30)
(Joins sheet 38)
2 655 000 FEET
2 645 000 FEET
2 650 000 FEET
2 670 000 FEET
380 000 FEET
394 000 FEET
389 000 FEET
370 000 FEET
Naceville
563
MONTGOMERY COUNTY
East Branch Perkiomen Cr
Unami Creek
PENNSYLVANIA TURNPIKE
Scale 1:15 840
1 Mile
5 000 Feet
0
¼
½
¾
1
1000
2000
3000
4000
5000

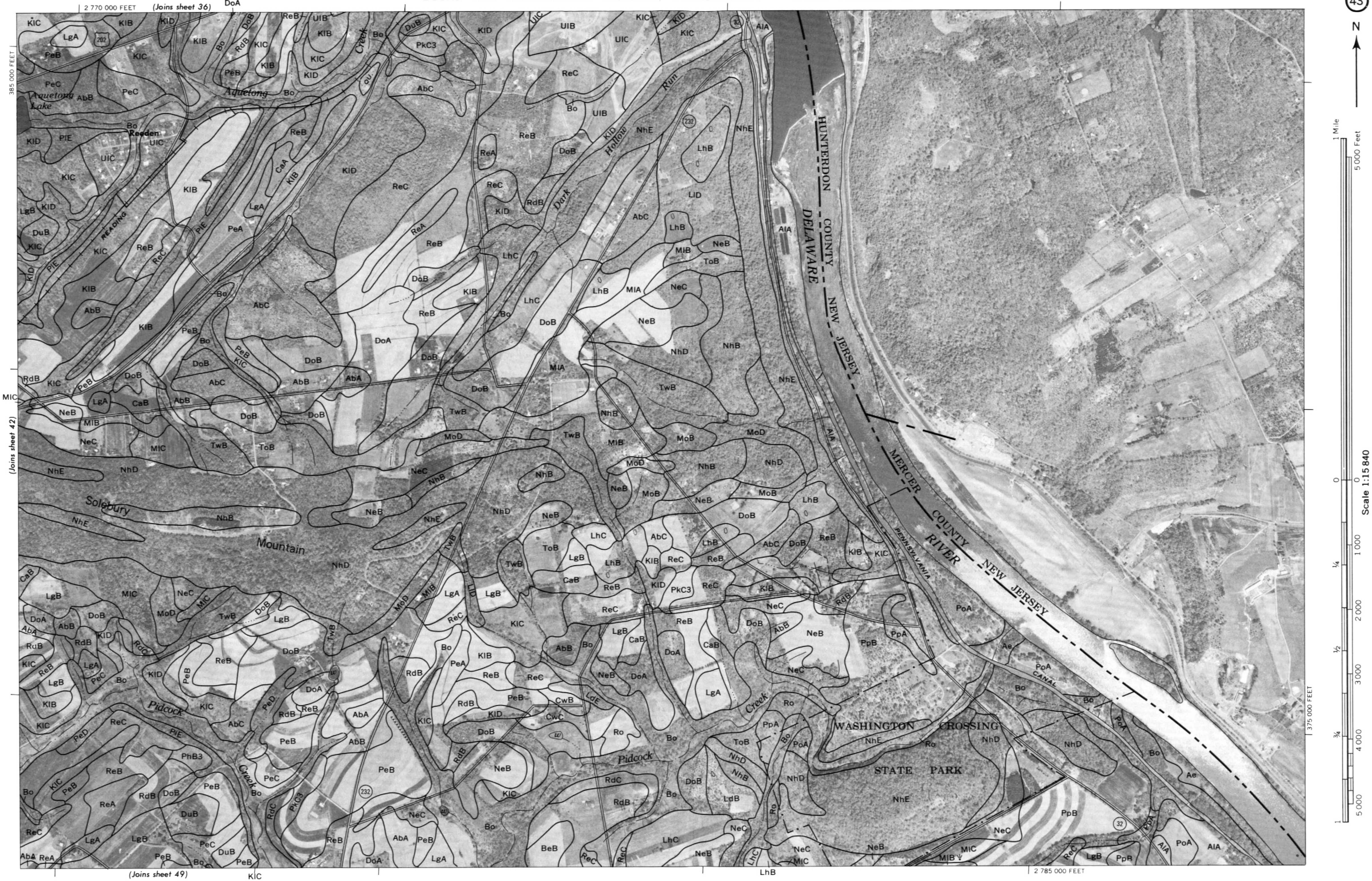

N
(Joins sheet 31)
2 690 000 FEET
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 44)
2 675 000 FEET
380 000 FEET
370 000 FEET
1 Mile
5000 Feet
Scale 1:15 840
SELLERSVILLE
Highland Park
Silverdale
Rockhill Church
Telford School
TELFORD
MONTGOMERY COUNTY
QUARRY
READING
East Branch Perkiomen Creek
Mill Creek
Pleasant Spring Creek


39
N
(Joins sheet 32)
(Joins sheet 38)
(Joins sheet 40)
(Joins sheet 45)
2 695 000 FEET
2 710 000 FEET
380 000 FEET
375 000 FEET
Hilltown School
Loux Corner
Naces Hollow
Mount Pleasant
Morris Run
QUARRY
113
152
Scale 1:15 840
1 Mile
5 000 Feet
0
¼
½
¾
1
1000
2000
3000
4000
5000


(Joins sheet 33)
(Joins sheet 39)
(Joins sheet 41)
(Joins sheet 46)
N
Scale 1:15 840
1 Mile
5 000 Feet
2 730 000 FEET
2 715 000 FEET
380 000 FEET
375 000 FEET
Danboro
Kendigtown
Fountainville
New Galena
Pine Run
Cross Keys
Neshaminy Creek
North Branch
Pine Run
313
611


41
N
(Joins sheet 34)
(Joins sheet 40)
(Joins sheet 42)
(Joins sheet 47)
2 735 000 FEET
2 750 000 FEET
380 000 FEET
375 000 FEET
Landisville
Mechanicsville
Buckingham
CENTRAL BUCKS COUNTY
MUNICIPAL AIRPORT
Pine
Run
water
QUARRY
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾


N
(Joins sheet 35)
(Joins sheet 41)
(Joins sheet 43)
(Joins sheet 48)
Scale 1:15 840
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
¼
½
¾
1
2 765 000 FEET
385 000 FEET
375 000 FEET
2 755 000 FEET
Aquetong Lake
Aquetong
Lahaska
Holicong
Five Points
Glendale
Buckingham
Buckingham Mountain
Lahaska Creek
Pidcock Cr
READING
QUARRY
water
G.P.
283
202

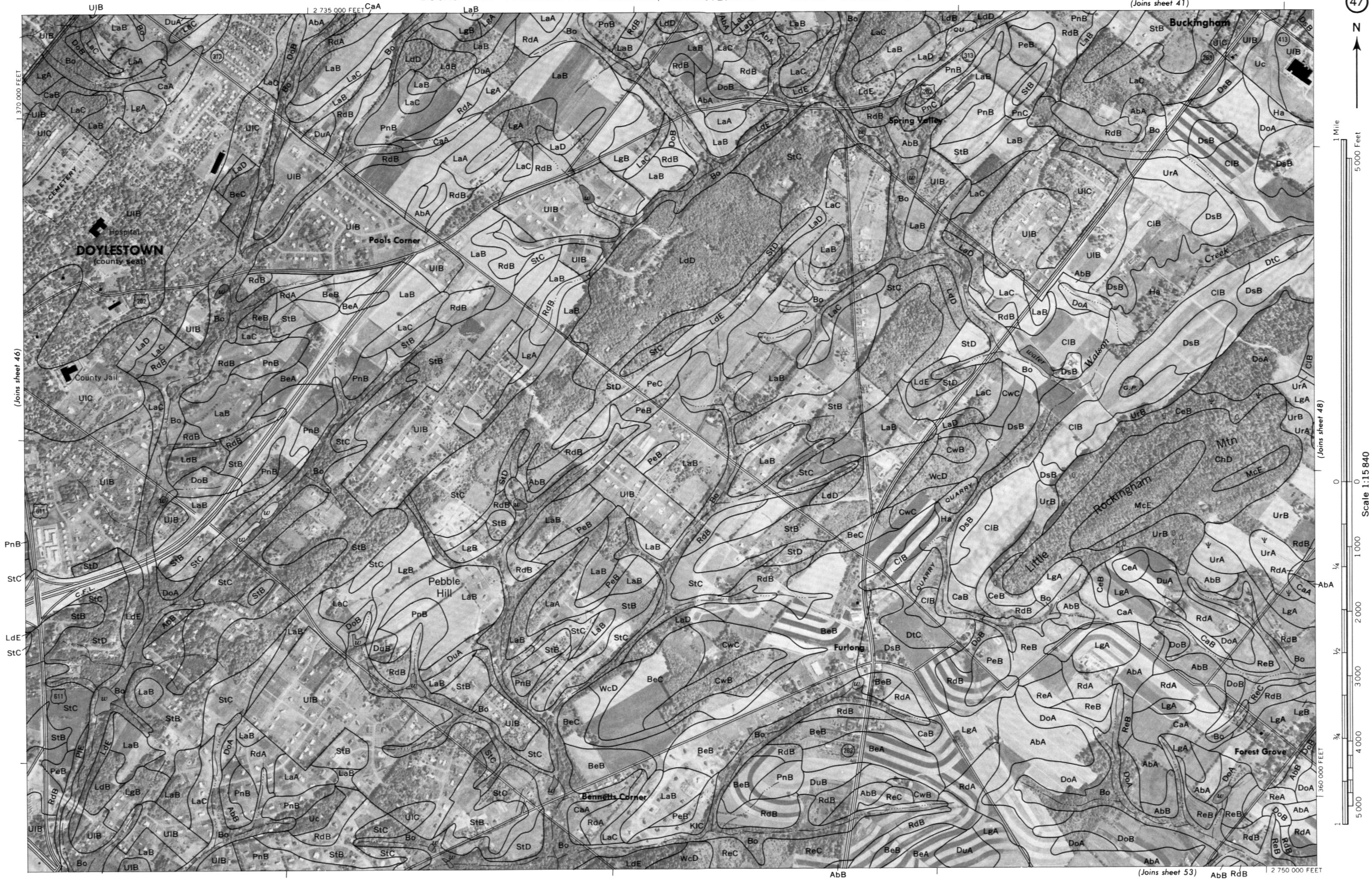

43
N
(Joins sheet 36)
2 770 000 FEET
385 000 FEET
(Joins sheet 42)
(Joins sheet 49)
2 785 000 FEET
375 000 FEET
Aquetong Lake
Reeden
READING
Aquetong
Creek
Dark Hollow Run
Solebury Mountain
Pidcock Creek
Pidcock
HUNTERDON COUNTY
DELAWARE RIVER
NEW JERSEY
MERCER COUNTY
PENNSYLVANIA
CANAL
WASHINGTON CROSSING STATE PARK
1 Mile
5 000 Feet
Scale 1:15 840

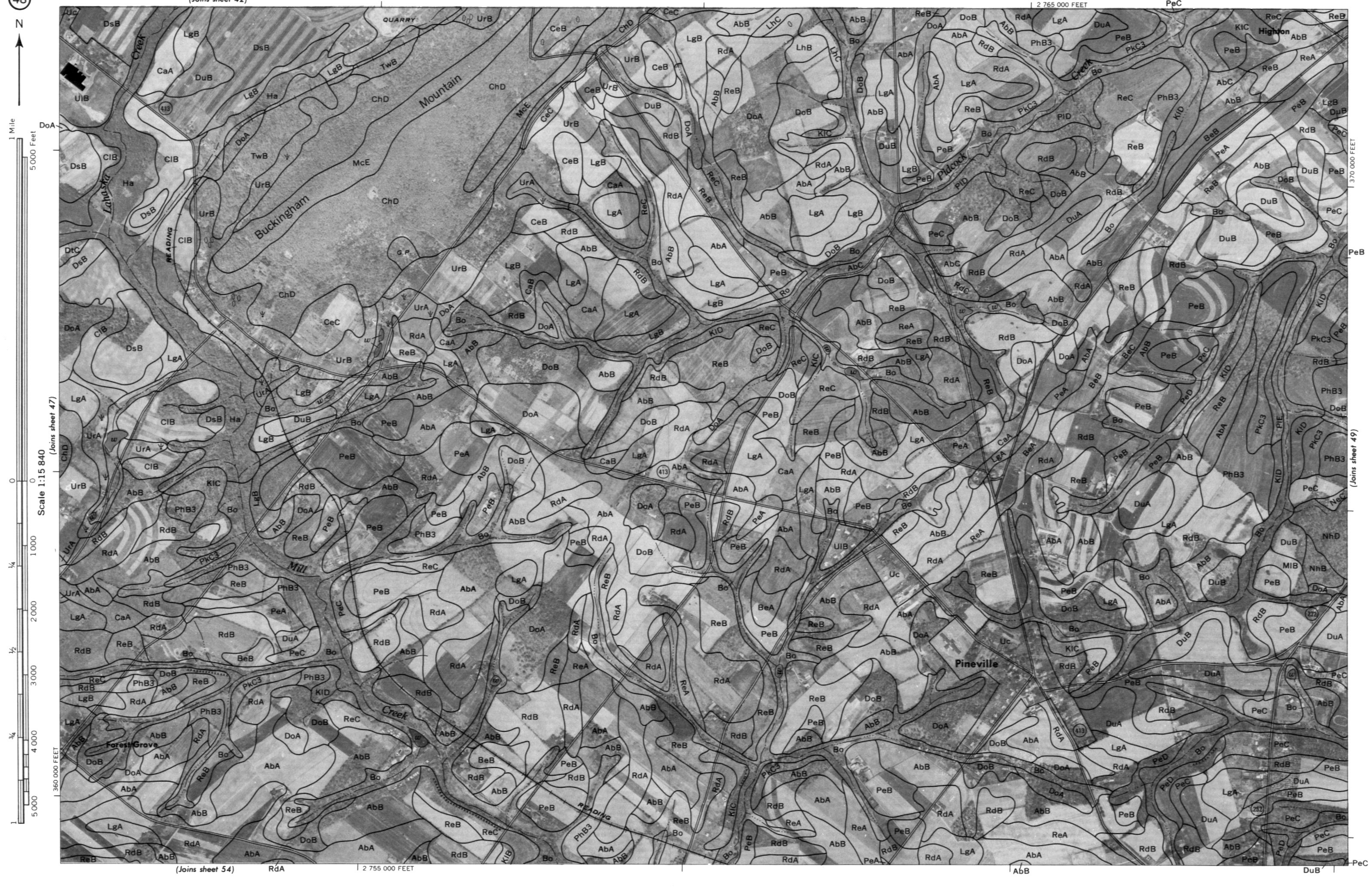
N

1 Mile
5000 Feet
0
Scale 1:15 840
1000
¼
2000
½
3000
¾
4000
5000
1


45
N
(Joins sheet 39)
(Joins sheet 44)
(Joins sheet 46)
(Joins sheet 51)
2 695 000 FEET
2 710 000 FEET
370 000 FEET
360 000 FEET
Leidytown
St Peters Church
Newville
Line Lexington
Chalfont
Berger Sch
NORTH BRANCH NESHAMINY CREEK
Pine Run
READING
1 Mile
5000 Feet
Scale 1:15 840


N
Scale 1:15 840
1 Mile
5000 Feet
(Joins sheet 40)
(Joins sheet 45)
(Joins sheet 47)
(Joins sheet 52)
2 730 000 FEET
370 000 FEET
360 000 FEET
2 715 000 FEET
DOYLESTOWN
(county seat)
New Britain
Farm School
N BR NESHAMINY CR
NESHAMINY CREEK
Pine Run
Run
Cooks Run
READING
CUT AND FILL LAND
611
202

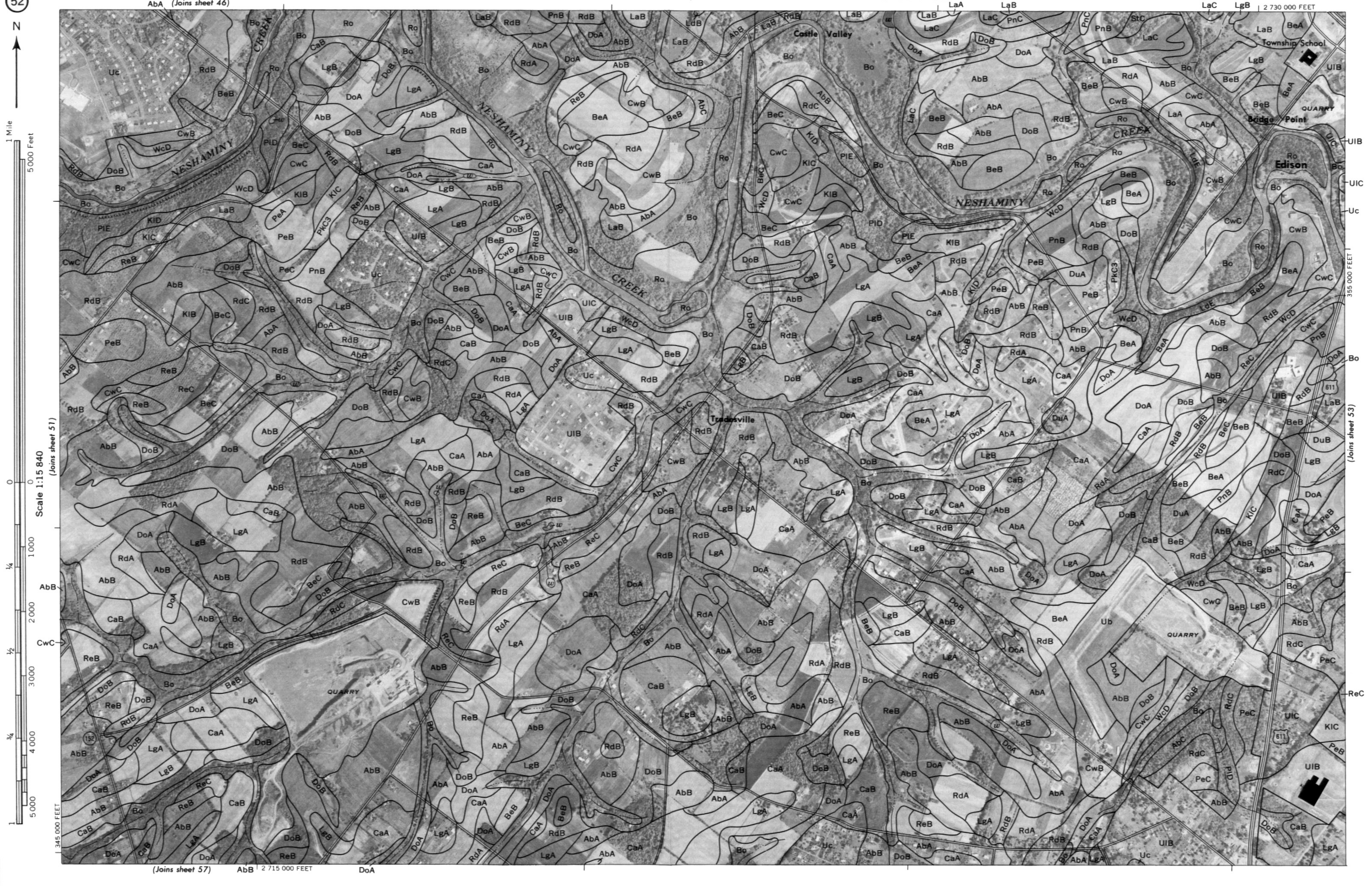

N
(Joins sheet 41)
(Joins sheet 46)
(Joins sheet 48)
(Joins sheet 53)
2 735 000 FEET
2 750 000 FEET
370 000 FEET
360 000 FEET
Buckingham
Spring Valley
DOYLESTOWN
(county seat)
Hospital
CEMETERY
County Jail
Pools Corner
Pebble
Hill
Furlong
Bennetts Corner
Forest Grove
Little
Rockingham
Mtn
Watson
Creek
QUARRY
water
C.F.L.
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1000
2000
3000
4000
5000


(Joins sheet 42)
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 54)
N
2 765 000 FEET
2 755 000 FEET
370 000 FEET
360 000 FEET
Scale 1:15 840
1 Mile
5000 Feet
QUARRY
Buckingham Mountain
Lahaska Creek
Mill Creek
Pidcock Creek
READING
Highton
Pineville
Forest Grove
G.P.


49
N
(Joins sheet 43)
(Joins sheet 48)
(Joins sheet 50)
(Joins sheet 55)
2 770 000 FEET
370 000 FEET
365 000 FEET
2 785 000 FEET
WASHINGTON CROSSING STATE PARK
Brownsburg
Highton
Buckmanville
Woodhill
Pidcock Creek
Jericho Mountain
Jericho Creek
Scale 1:15 840
1 Mile
5 000 Feet


N
Scale 1:15 840
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
¼
½
¾
1
2 805 000 FEET
370 000 FEET
365 000 FEET
2 790 000 FEET
(Joins sheet 49)
(Joins sheet 56)
DELAWARE RIVER
MERCER COUNTY
NEW JERSEY
PENNSYLVANIA
CANAL
Jericho Creek
WASHINGTON CROSSING STATE PARK
Washington Crossing
Taylorsville
GRAVEL PIT
water
32
532
Ae
Bo
AlA
PoA
RdB
PpB
PeC
PeD
PeB
DoA
PnB
PkC3
PpA
LgA
PIE
PeA
KID
KIC
UIC
PhB3
ReB
DoB
BeB
PnC
RdB
ReC
LgB
PID
DuB
AbB
UIB


51
N
(Joins sheet 45)
(Joins sheet 52)
(Joins inset)
2 695 000 FEET
2 710 000 FEET
355 000 FEET
345 000 FEET
Chalfont
WEST BRANCH
NORTH BRANCH
NESHAMINY CREEK
NESHAMINY CR
READING
MONTGOMERY COUNTY
1 Mile
5 000 Feet
Scale 1:15 840
2 709 000 FEET
(Joins lower right)
(Joins 57)
344 000 FEET
342 000 FEET
2 712 000 FEET
2000 AND 3000-FOOT GRID TICKS

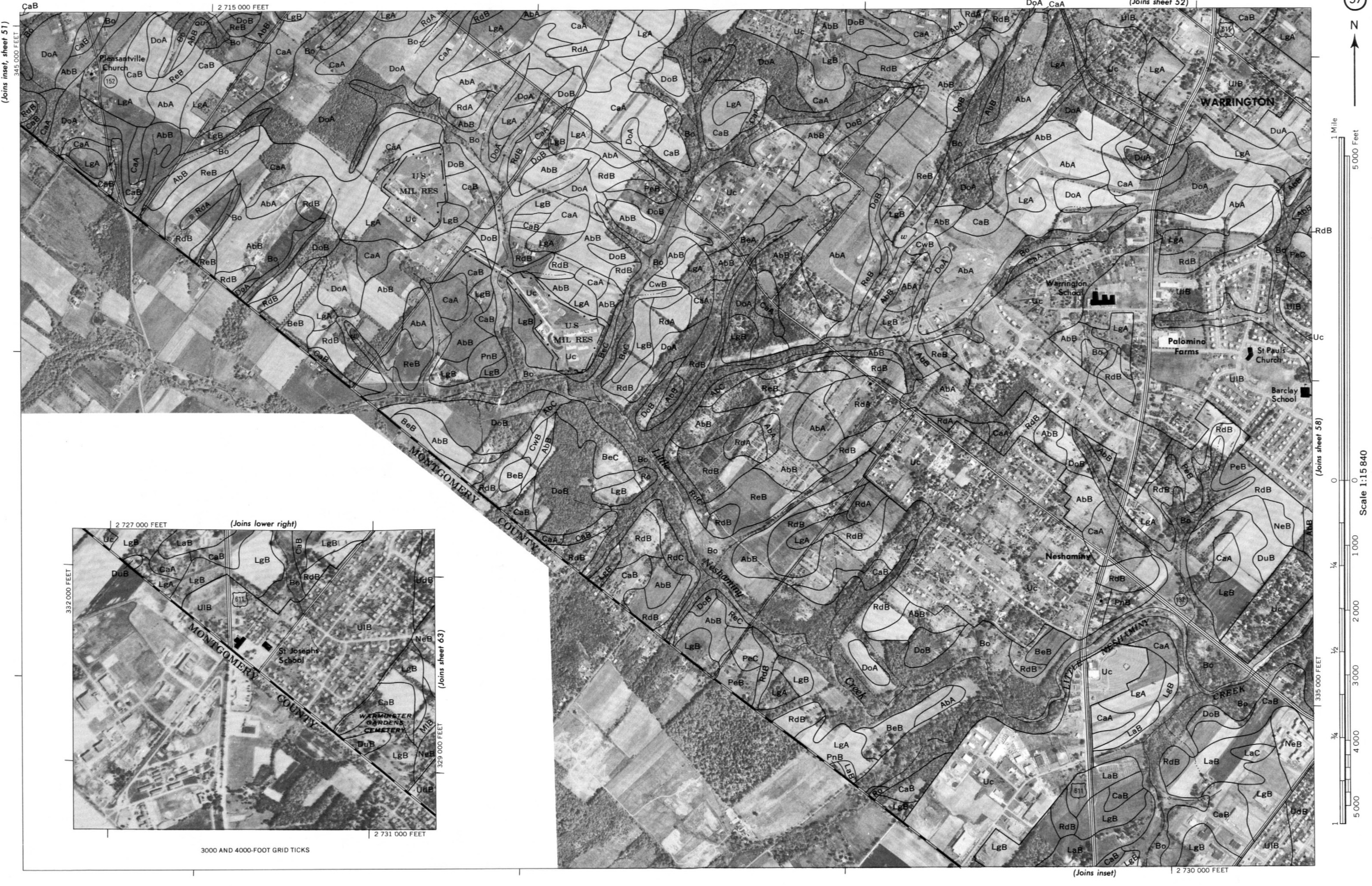

52
N
(Joins sheet 46)
(Joins sheet 51)
(Joins sheet 53)
(Joins sheet 57)
Scale 1:15 840
1 Mile
5000 Feet
2 730 000 FEET
2 715 000 FEET
355 000 FEET
345 000 FEET
NESHAMINY
CREEK
Castle Valley
Township School
Bridge Point
QUARRY
Edison
Tradesville
611
152


(Joins sheet 47)
(Joins sheet 52)
(Joins sheet 54)
(Joins sheet 58)
2 735 000 FEET
2 750 000 FEET
355 000 FEET
380 000 FEET
QUARRY
Bridge Valley
Jamison
NESHAMINY
CREEK
NESHAMINY
CREEK
611
263
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1


(Joins sheet 48)
(Joins sheet 53)
(Joins sheet 55)
(Joins sheet 59)
N
Scale 1:15 840
1 Mile
5000 Feet
2 770 000 FEET
2 755 000 FEET
355 000 FEET
350 000 FEET
Wycombe
Mozart
Penns Park
Rushland
QUARRY
Mill Creek
Robin Run
NESHAMINY CREEK
L. NESHAMINY CR
READING


55
(Joins sheet 49)
(Joins sheet 54)
(Joins sheet 56)
(Joins sheet 60)
2 775 000 FEET
2 785 000 FEET
355 000 FEET
350 000 FEET
Wrightstown
Ryans Corner
Stoopville
Houghs Creek
Newtown Creek
N
1 Mile
5000 Feet
Scale 1:15 840


N
(Joins sheet 50)
(Joins sheet 55)
(Joins sheet 61)
(Joins inset, sheet 62)
2 805 000 FEET
360 000 FEET
350 000 FEET
2 790 000 FEET
Scale 1:15 840
1 Mile
5 000 Feet
Dolington
Houghs Creek
Dyers Creek
Core Creek
DELAWARE RIVER
MERCER COUNTY
NEW JERSEY
PENNSYLVANIA
CANAL

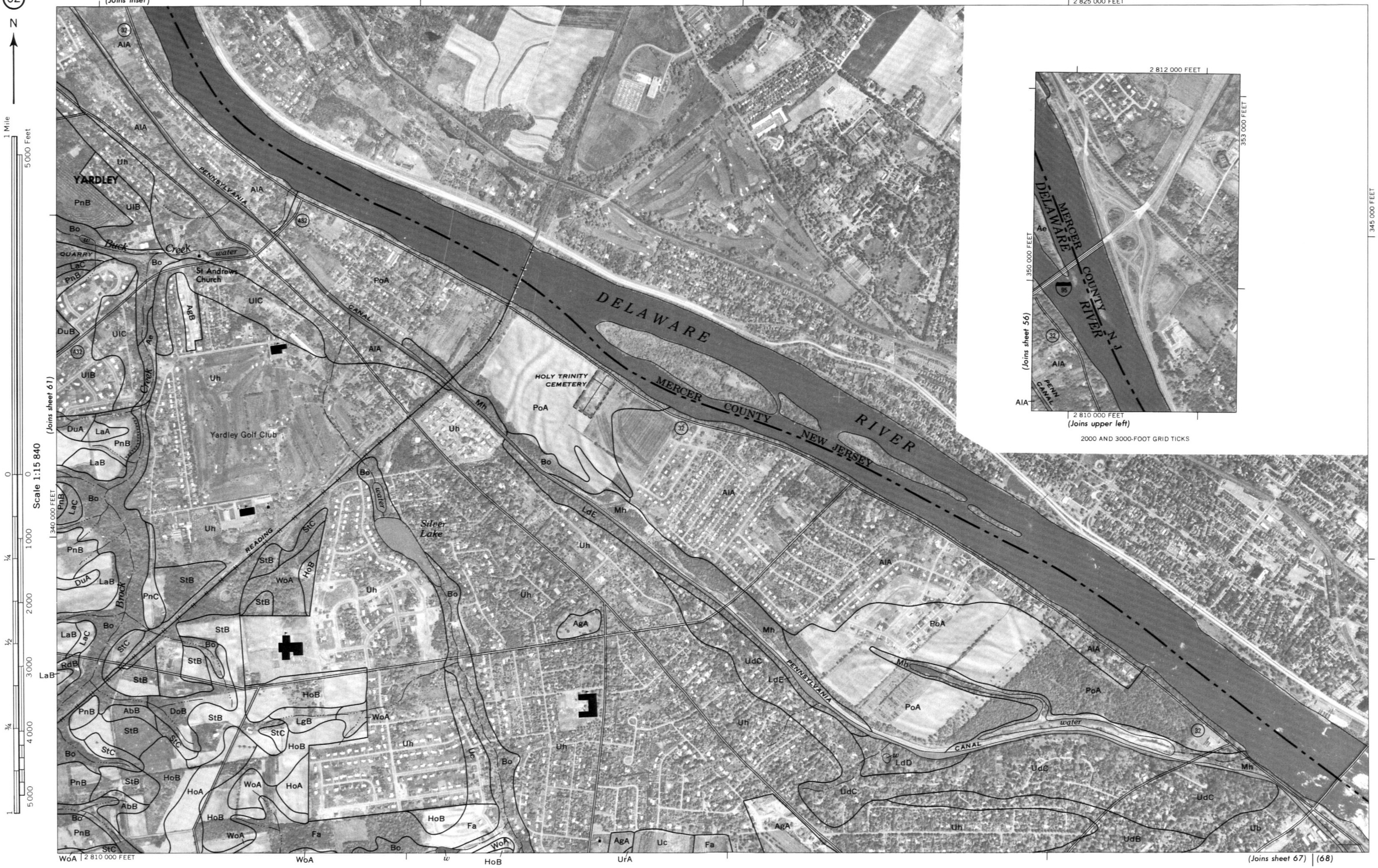

(Joins sheet 52)
(Joins inset, sheet 51)
(Joins sheet 58)
(Joins inset)
(Joins lower right)
(Joins sheet 63)
2 715 000 FEET
345 000 FEET
2 727 000 FEET
332 000 FEET
329 000 FEET
2 731 000 FEET
335 000 FEET
2 730 000 FEET
3000 AND 4000-FOOT GRID TICKS
N
Scale 1:15 840
1 Mile
5000 Feet
WARRINGTON
Pleasantville Church
U.S. MIL. RES.
Warrington School
Palomino Farms
St Pauls Church
Barclay School
Neshaminy
Little Neshaminy Creek
LITTLE NESHAMINY CREEK
MONTGOMERY COUNTY
St Josephs School
WARMINSTER GARDENS CEMETERY
152
611

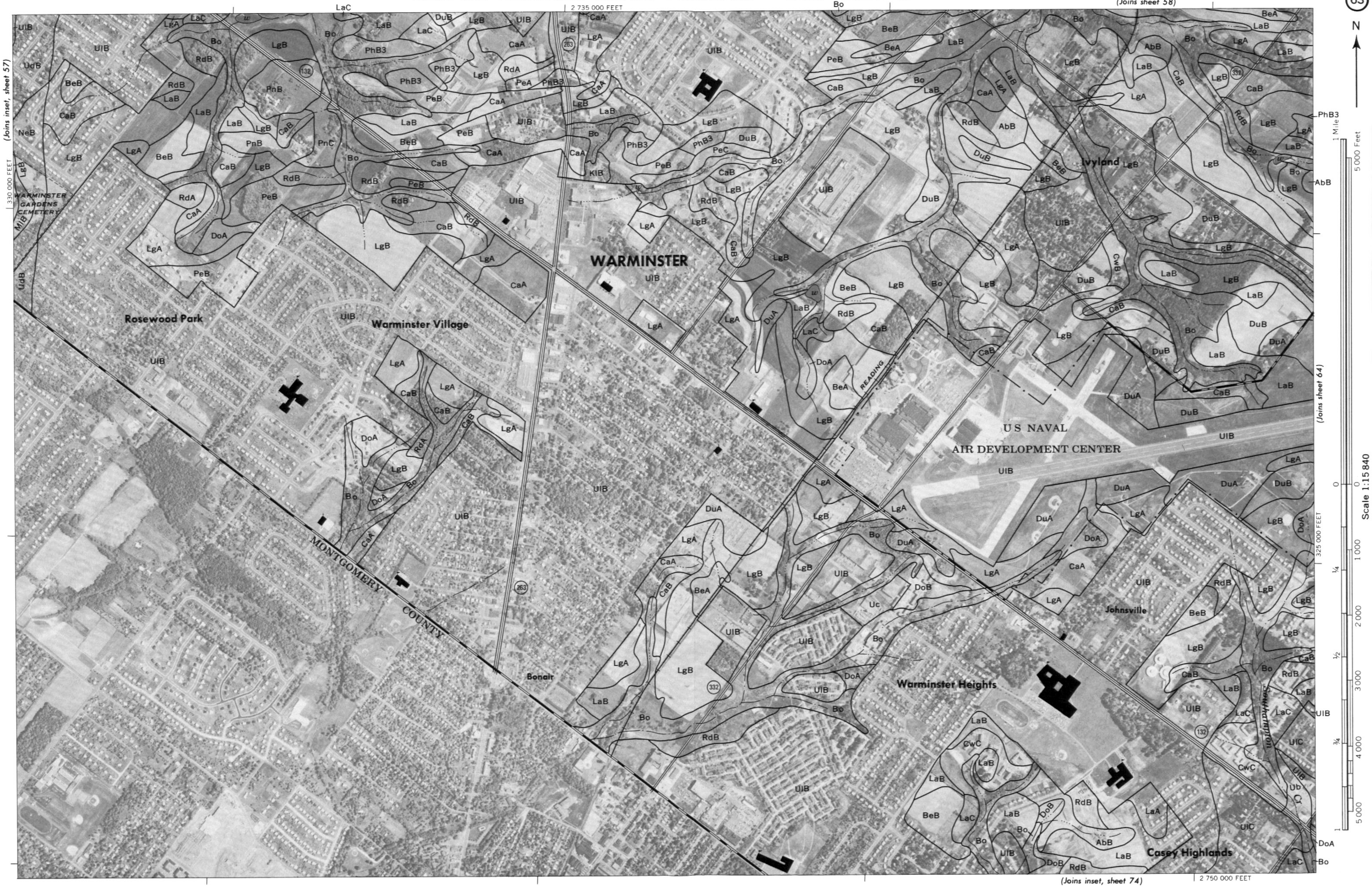
BUCKS AND PHILADELPHIA COUNTIES, PENNSYLVANIA — SHEET NUMBER 58


59
N
(Joins sheet 54)
(Joins sheet 58)
(Joins sheet 60)
(Joins sheet 64)
2 755 000 FEET
2 770 000 FEET
345 000 FEET
335 000 FEET
QUARRY
NESHAMINY CREEK
LITTLE NESHAMINY CREEK
READING
Jacksonville
Richboro
UNION CEMETERY
water
232
332
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
0
1000
2000
3000
4000
5000


N
(Joins sheet 55)
(Joins sheet 59)
(Joins sheet 61)
(Joins sheet 65)
2 785 000 FEET
2 775 000 FEET
345 000 FEET
335 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1
NESHAMINY
CREEK
Newtown
Creek
Edgeboro
Newtown
Goodnow School
Council Rock School
St Andrews Sch
READING
413
332
532


(Joins sheet 56)
(Joins sheet 60)
(Joins sheet 62)
(Joins sheet 66)
2 790 000 FEET
2 805 000 FEET
345 000 FEET
340 000 FEET
N
Scale 1:15 840
1 Mile
5 000 Feet
Scammels Corner
Silver Lake
Edgewood School
Woodside
Roelofs
Core Creek
Buck Creek
Brock Creek
QUARRY
READING
95
332
432


N
(Joins inset)
2 825 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
(Joins sheet 61)
340 000 FEET
YARDLEY
PENNSYLVANIA
CANAL
READING
Buck
Creek
Brock
water
QUARRY
St Andrews
Church
Yardley Golf Club
HOLY TRINITY
CEMETERY
Silver
Lake
DELAWARE
RIVER
MERCER
COUNTY
NEW JERSEY
AlA
Uh
UlB
UlC
PnB
PnC
Bo
LaC
LaB
LaA
DuB
DuA
AgB
AgA
Ae
PoA
Mh
LdE
LdD
StB
StC
WoA
HoB
HoA
AbB
DoB
LgB
RdB
Fa
Uc
Ub
UdC
UdB
UrA
2 810 000 FEET
(Joins sheet 67)
(68)
2 812 000 FEET
353 000 FEET
350 000 FEET
345 000 FEET
(Joins sheet 56)
PENN
CANAL
N.J.
2 810 000 FEET
(Joins upper left)
2000 AND 3000-FOOT GRID TICKS


63
(Joins sheet 58)
(Joins inset, sheet 57)
(Joins sheet 64)
(Joins inset, sheet 74)
2 735 000 FEET
2 750 000 FEET
330 000 FEET
325 000 FEET
N
Scale 1:15 840
1 Mile
5000 Feet
WARMINSTER
Rosewood Park
Warminster Village
WARMINSTER GARDENS CEMETERY
MONTGOMERY COUNTY
Bonair
Ivyland
U S NAVAL
AIR DEVELOPMENT CENTER
READING
Johnsville
Warminster Heights
Casey Highlands
Southampton


N
(Joins sheet 59)
(Joins sheet 63)
(Joins sheet 65)
(Joins sheet 69)
2 770 000 FEET
330 000 FEET
325 000 FEET
2 755 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
UNION CEM
Richboro
Addisville Church
Council Rock Jr High School
US NAVAL
AIR DEVELOPMENT CENTER
Casey Village
Ironworks
Creek
Klinger Jr High School
Davisville
Churchville
READING
water
Springfield Lake


65
N
(Joins sheet 60)
(Joins sheet 64)
(Joins sheet 66)
(Joins sheet 70)
2 775 000 FEET
2 790 000 FEET
330 000 FEET
325 000 FEET
Villa Joseph Marie Sch
St Bedes School
Holland Station
Holland School
Neshaminy Jr High School
Bridgetown
NESHAMINY CREEK
Neutown
Pine Run
Core Creek
READING
PENN CENTRAL
532
413
Scale 1:15 840
1 Mile
5 000 Feet

66

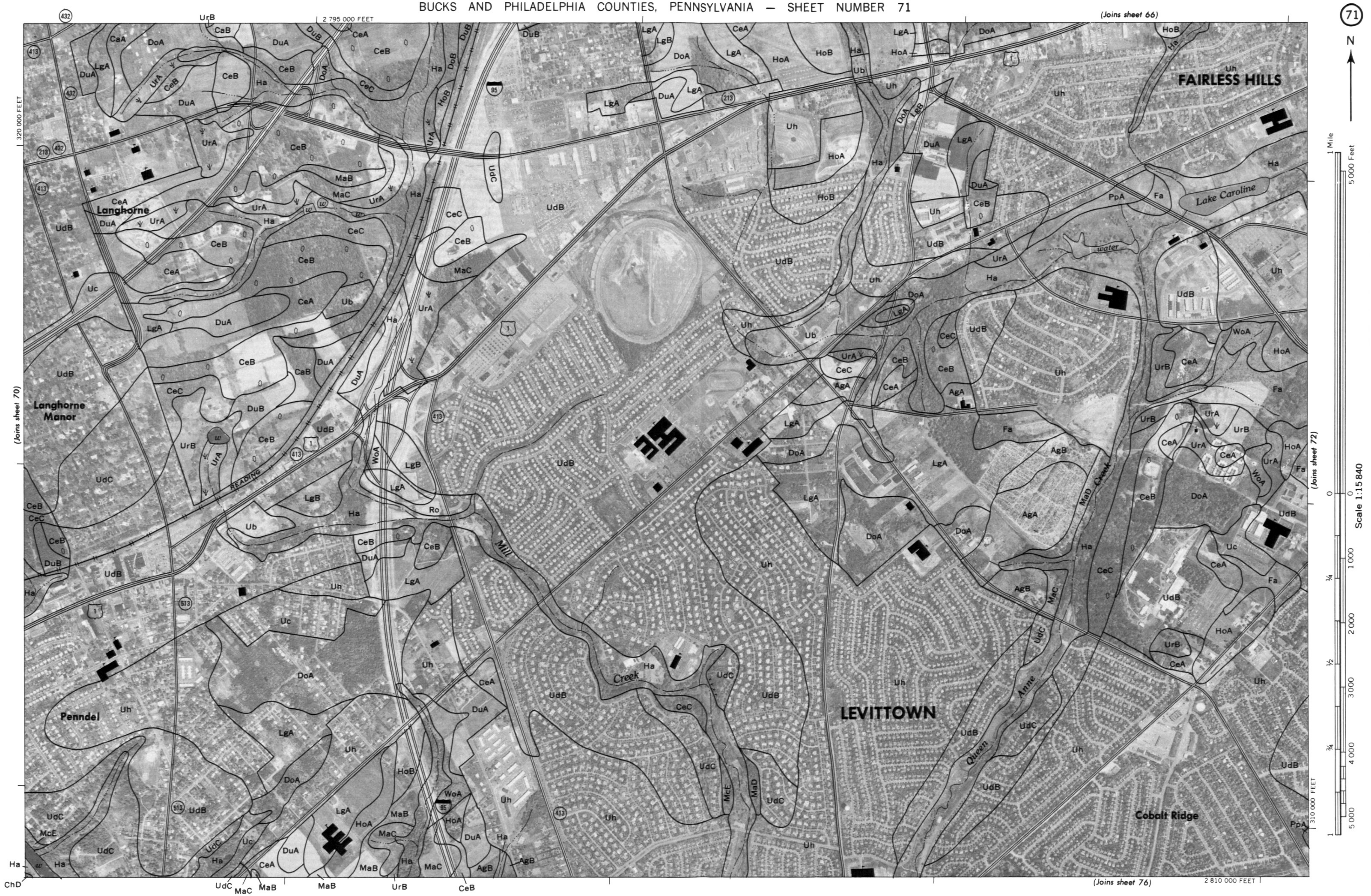

(Joins sheet 61)
(Joins sheet 65)
(Joins sheet 67)
(Joins sheet 71)
N
1 Mile
5 000 Feet
Scale 1:15 840
2 805 000 FEET
335 000 FEET
325 000 FEET
2 795 000 FEET
Maple Point
Woodbourne
Bucktoe
Oxford Valley
BORROW PIT
Brock Creek
Core Creek
Mill Creek
READING
PENN CENTRAL


67
N
(Joins sheet 62)
(Joins sheet 66)
(Joins sheet 68)
(Joins sheet 72)
2 810 000 FEET
335 000 FEET
2 825 000 FEET
325 000 FEET
Scale 1:15 840
1 Mile
5000 Feet
MORRISVILLE
Pennsbury High School
MORRISVILLE AIRPORT
Five Points
Fallsington
Curtis Lake
Rock Run
GRAVEL PIT
BORROW PIT
PENN CENTRAL
PENNSYLVANIA
CANAL
TUNNEL
water


(62)
2 845 000 FEET
335 000 FEET
N
1 Mile
5000 Feet
Scale 1:15 840
(Joins sheet 67)
325 000 FEET
2 830 000 FEET
(Joins sheet 73)
MORRISVILLE
PENNSYLVANIA CANAL
DELAWARE
RIVER
MERCER
COUNTY
NEW
JERSEY
BILES
CREEK
PENN
CENTRAL
GRAVEL PIT
water
Ub
Uh
PpA
PoA
Mh
AgA
AgB
w

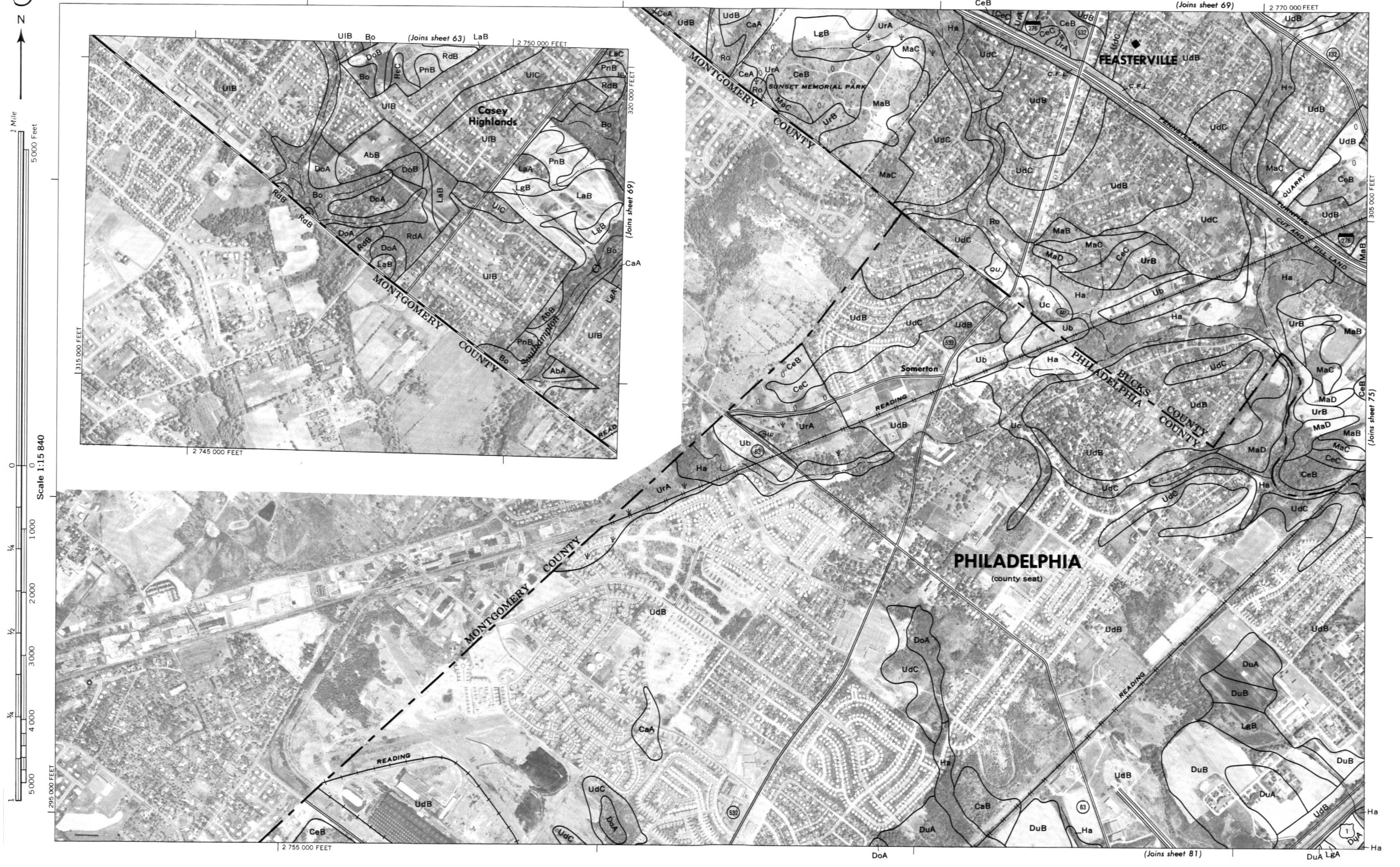

69
N
(Joins sheet 64)
(Joins inset, sheet 74)
(Joins sheet 70)
(Joins sheet 74)
2 755 000 FEET
2 770 000 FEET
320 000 FEET
310 000 FEET
SOUTHAMPTON
FEASTERVILLE
Springfield
Lake
Mill Creek
Ironworks Creek
Southampton Cr.
MONTGOMERY COUNTY
PENNSYLVANIA TURNPIKE
CUT AND FILL LAND
PENN CENTRAL
READING
SUNSET MEMORIAL PARK
WHITE CHAPEL GARDENS
water
1 Mile
5000 Feet
Scale 1:15 840


70
N
(Joins sheet 65)
(Joins sheet 69)
(Joins sheet 71)
(Joins sheet 75)
2 790 000 FEET
2 775 000 FEET
320 000 FEET
310 000 FEET
Scale 1:15 840
1 Mile
5000 Feet
Holland
Roxton Station
Assumption School
Trevose Heights
Siles
Oakford
Neshaminy Woods
Neshaminy Hills
Langhorne Terrace
Idlewood
Neshaminy High School
Langhorne
Parkland
Parkland Heights
CEMETERY
QUARRY
NESHAMINY CREEK
Mill Creek
Pine Creek
Ironworks
PENN CENTRAL
READING


71
N
(Joins sheet 66)
(Joins sheet 70)
(Joins sheet 72)
(Joins sheet 76)
2 795 000 FEET
2 810 000 FEET
320 000 FEET
310 000 FEET
FAIRLESS HILLS
Lake Caroline
Langhorne
Langhorne Manor
Penndel
LEVITTOWN
Cobalt Ridge
Mill Creek
Queen Anne
READING
water
1 Mile
5 000 Feet
Scale 1:15 840

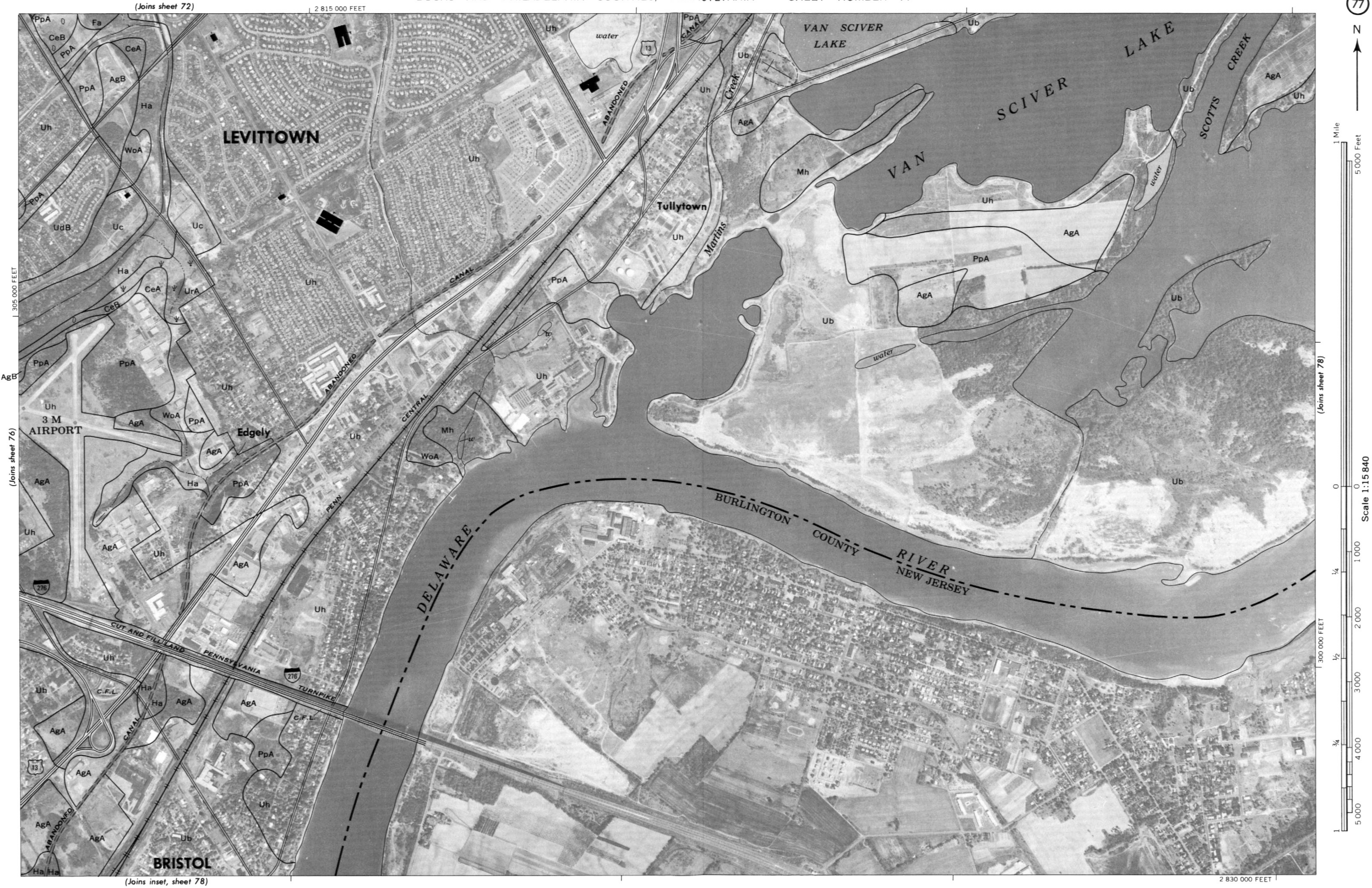

(Joins sheet 67)
(Joins sheet 71)
(Joins sheet 73)
(Joins sheet 77)
2 825 000 FEET
2 815 000 FEET
320 000 FEET
310 000 FEET
Scale 1:15 840
1 Mile
5000 Feet
FAIRLESS HILLS
Vermillion Hill
Thornridge
Penn Valley
North Park
Magnolia Hill
Wheat Sheaf
Holly Hill
Appletree Hill
Crabtree Hollow
Red Cedar Hill
Lakeside
LEVITTOWN
VAN SCIVER LAKE
Martins Creek
Rock Run
SCOTTS CREEK
ABANDONED CANAL
PENN
TUNNEL
GRAVEL PIT
water

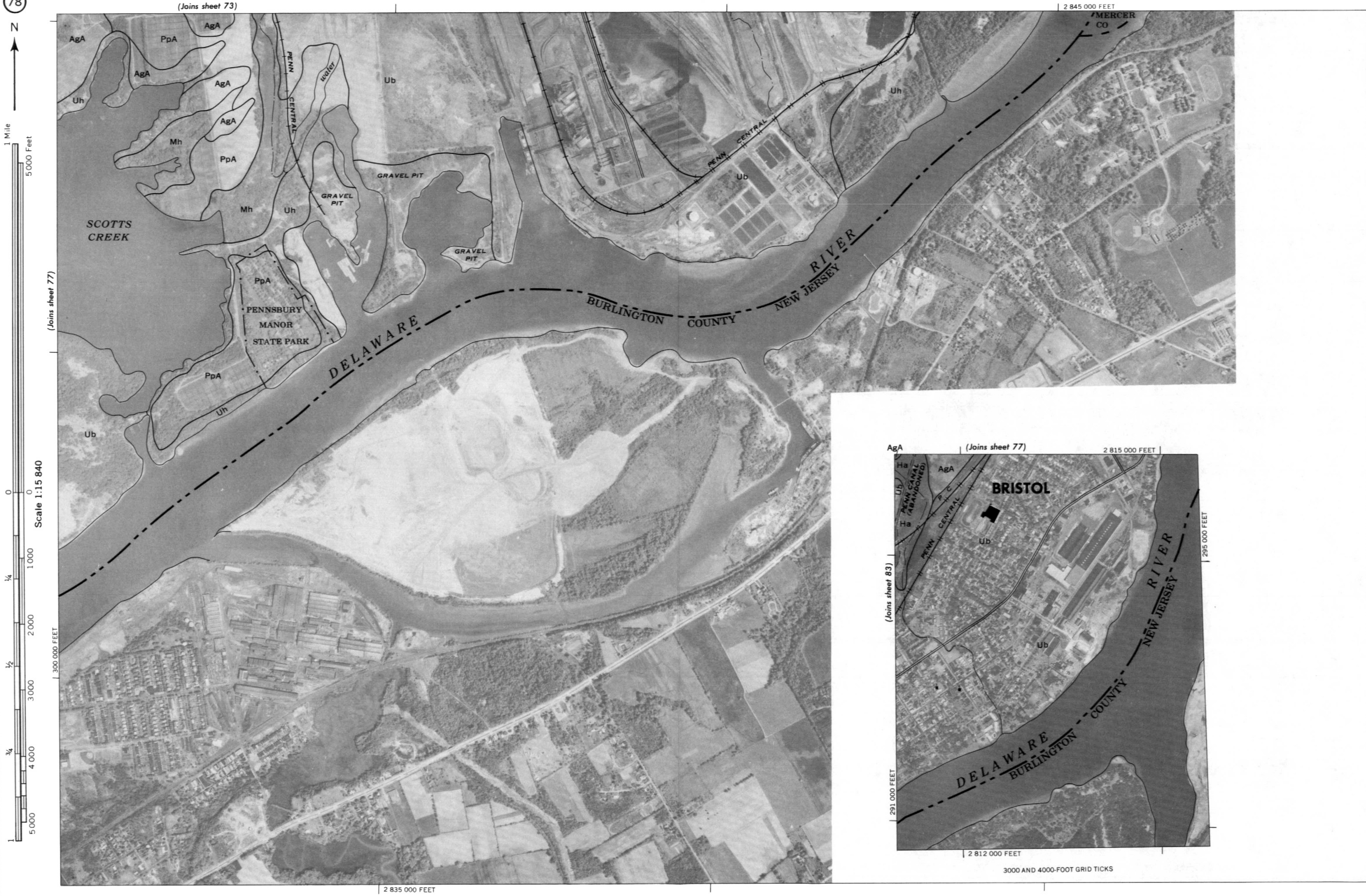

73
N
(Joins sheet 68)
(Joins sheet 72)
(Joins sheet 78)
2 830 000 FEET
2 845 000 FEET
320 000 FEET
315 000 FEET
VAN SCIVER LAKE
Turkey Hill
Biles Island
BILES CREEK
Echo Point
DELAWARE RIVER
MERCER COUNTY
NEW JERSEY
SCOTTS CREEK
GRAVEL PIT
QUARRY
PENN CENTRAL
1 Mile
5 000 Feet
Scale 1:15 840
AgA
AgB
PpA
Uh
Ub
Mh
Fa
w
water


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 63)
(Joins sheet 69)
(Joins sheet 75)
(Joins sheet 81)
2 750 000 FEET
2 745 000 FEET
2 755 000 FEET
2 770 000 FEET
320 000 FEET
315 000 FEET
305 000 FEET
295 000 FEET
Casey Highlands
Southampton
MONTGOMERY COUNTY
BUCKS COUNTY
PHILADELPHIA COUNTY
FEASTERVILLE
SUNSET MEMORIAL PARK
PENNSYLVANIA TURNPIKE
QUARRY
CUT AND FILL LAND
Somerton
READING
PHILADELPHIA
(county seat)


75
N
2 775 000 FEET
305 000 FEET
300 000 FEET
2 790 000 FEET
(Joins sheet 70)
(Joins sheet 74)
(Joins sheet 76)
(Joins sheet 82)
TREVOSE
La Trappe
Linconia
Nottingham
ROOSEVELT
CEMETERY
Samuel K. Faust
School
United
Church
Bensalem
Church
NESHAMINY CREEK
Poquessing
Creek
BUCKS COUNTY
PHILADELPHIA COUNTY
READING
PENNSYLVANIA TURNPIKE
CUT AND FILL LAND
C.F.L.
Scale 1:15 840
1 Mile
5 000 Feet
1000
2000
3000
4000
5000
¼
½
¾
0


76
N
(Joins sheet 71)
(Joins sheet 75)
(Joins sheet 77)
(Joins sheet 83)
Scale 1:15 840
1 Mile
5000 Feet
2 810 000 FEET
305 000 FEET
300 000 FEET
2 795 000 FEET
LEVITTOWN
Hulmeville
Newportville
Flushing
Midway
Margo Gardens
Bristol Terrace
Rockdale
Silver Lake
GREENWOOD CEMETERY
NESHAMINY CREEK
Mill Creek
Queen Anne Creek
PENNSYLVANIA TURNPIKE
DELAWARE EXPRESSWAY
INTERCHANGE 29
CUT AND FILL LAND
GRAVEL PIT
QUARRY
water


(Joins sheet 72)
2 815 000 FEET
77
N
LEVITTOWN
Tullytown
Edgely
3 M AIRPORT
BRISTOL
VAN SCIVER LAKE
VAN SCIVER LAKE
SCOTTS CREEK
Martins Creek
CANAL
ABANDONED
CENTRAL
PENN
DELAWARE RIVER
BURLINGTON COUNTY
NEW JERSEY
CUT AND FILL LAND
PENNSYLVANIA TURNPIKE
C.F.L.
water
305 000 FEET
300 000 FEET
2 830 000 FEET
(Joins sheet 76)
(Joins sheet 78)
(Joins inset, sheet 78)
1 Mile
5 000 Feet
Scale 1:15 840
PpA
CeB
CeA
Fa
AgB
Ha
Uh
WoA
UdB
Uc
UrA
AgA
Mh
Ub
Ha
276
13


78
N
(Joins sheet 73)
(Joins sheet 77)
2 845 000 FEET
310 000 FEET
300 000 FEET
2 835 000 FEET
MERCER CO
AgA
PpA
Uh
Mh
Ub
PENN CENTRAL
water
GRAVEL PIT
SCOTTS CREEK
PENNSBURY MANOR STATE PARK
DELAWARE RIVER
BURLINGTON COUNTY
NEW JERSEY
1 Mile
5000 Feet
Scale 1:15 840
BRISTOL
Ha
PENN CANAL (ABANDONED)
P C
(Joins sheet 83)
2 815 000 FEET
2 812 000 FEET
295 000 FEET
291 000 FEET
3000 AND 4000-FOOT GRID TICKS

79

N

2 695 000 FEET

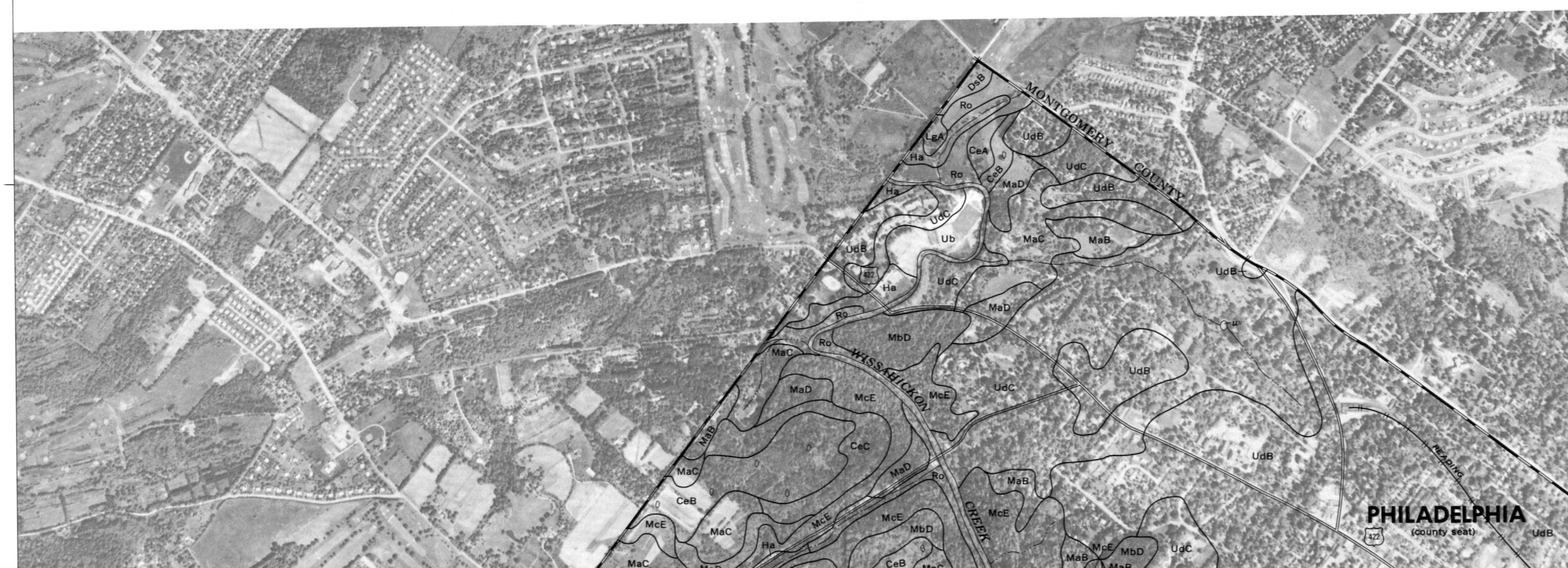
290 000 FEET

2 715 000 FEET

2 720 000 FEET

(Joins sheet 85)

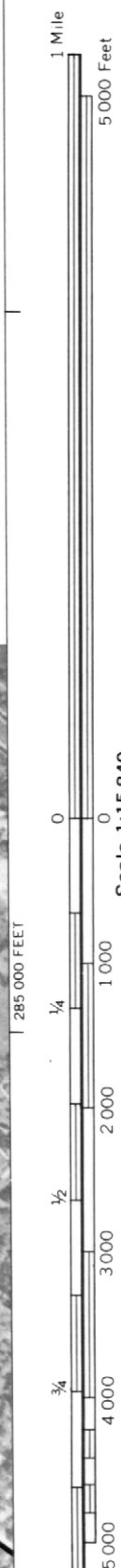
2000 AND 5000-FOOT GRID TICKS



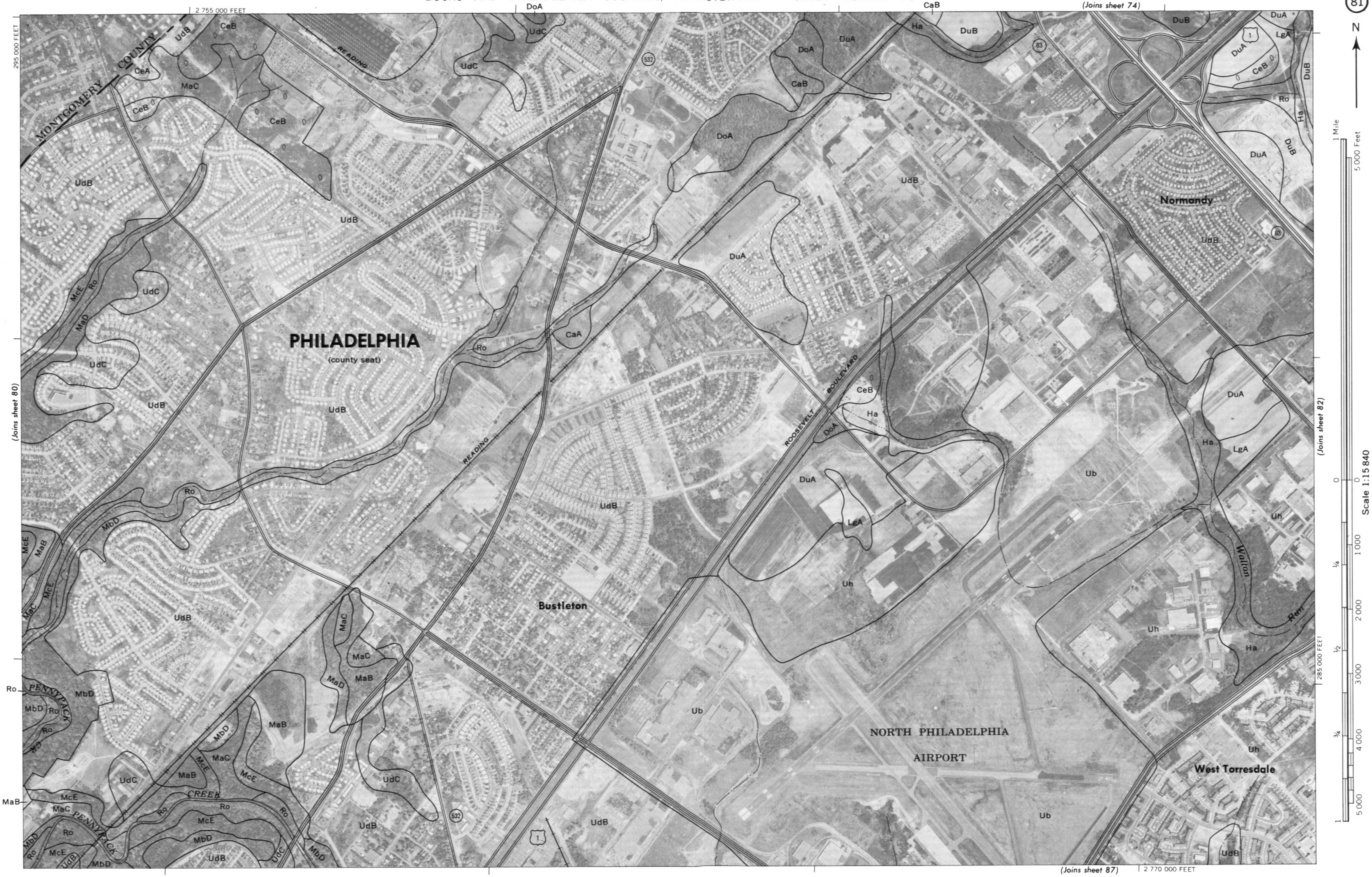
2 710 000 FEET

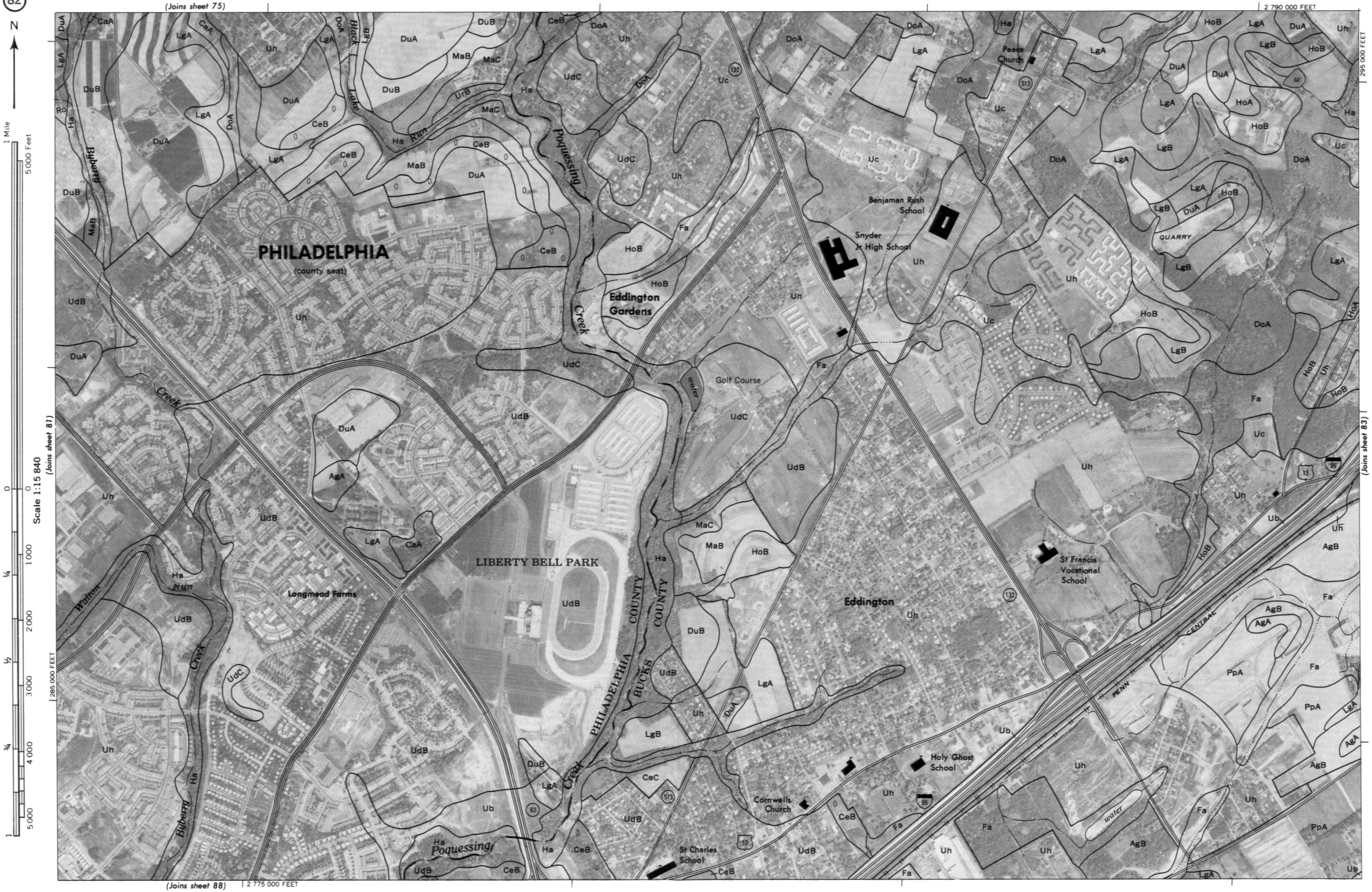
(Joins sheet 84)

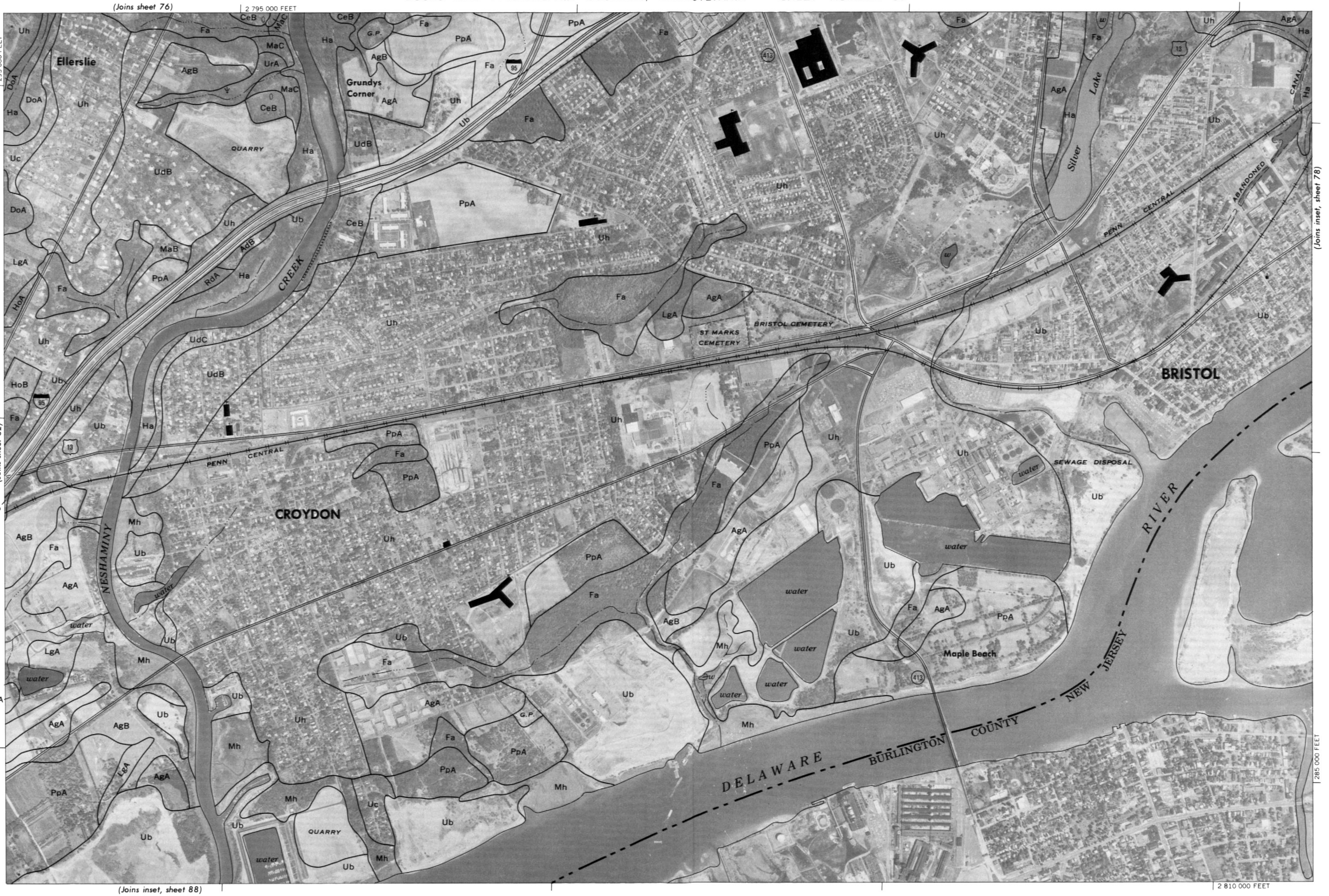
(inset)



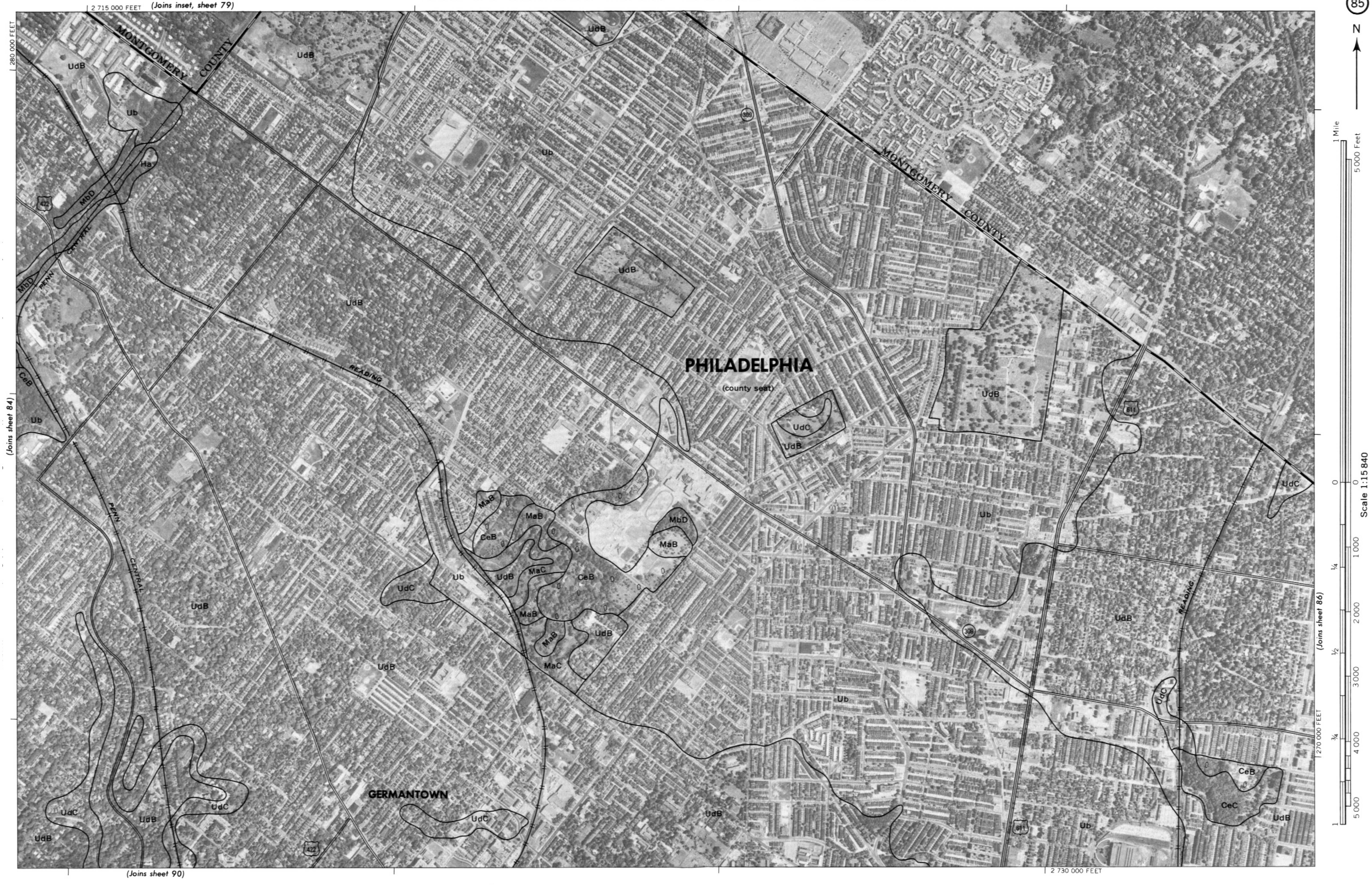
BUCKS AND PHILADELPHIA COUNTIES, PENNSYLVANIA — SHEET NUMBER 80

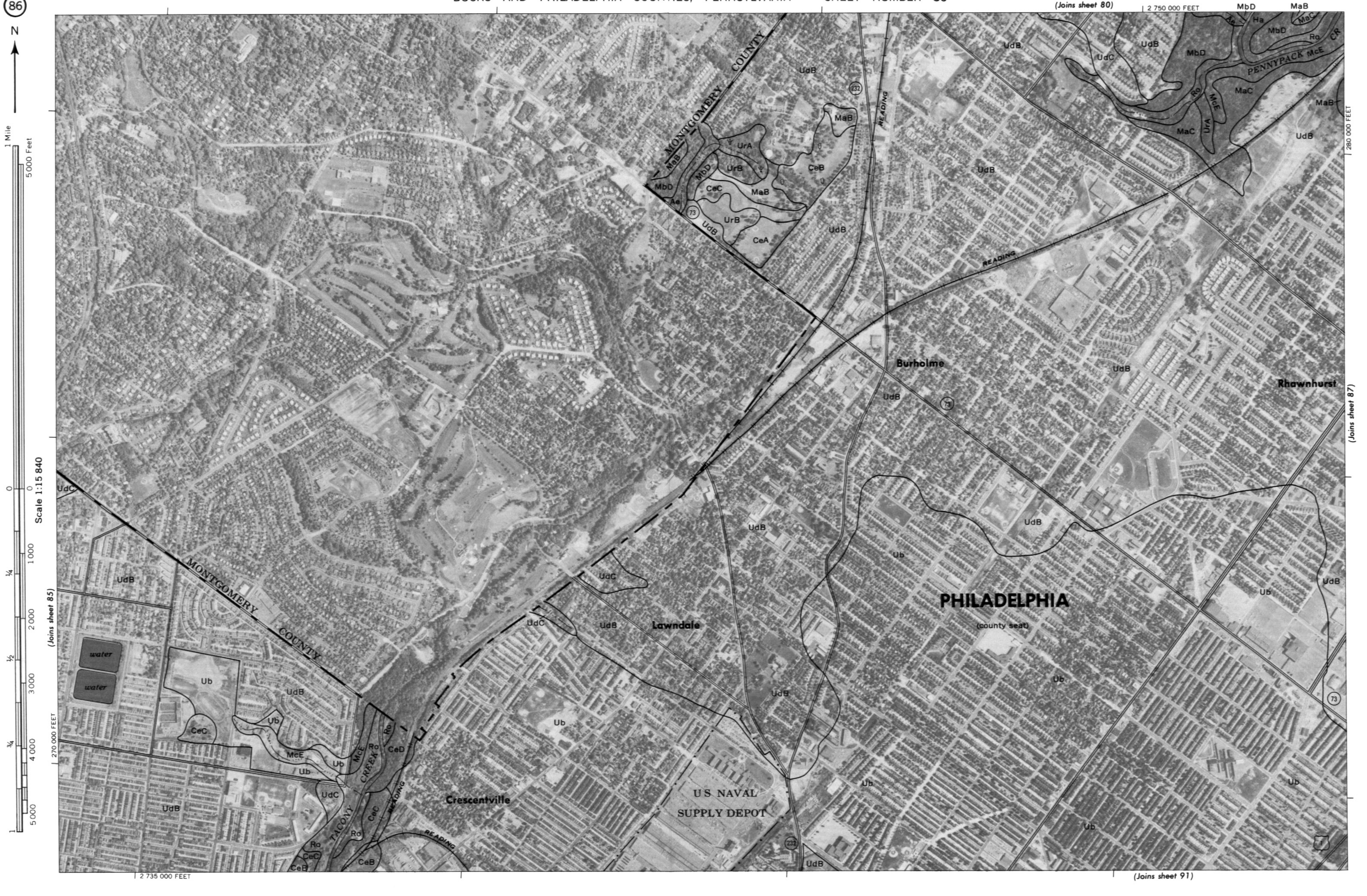

2 755 000 FEET
295 000 FEET
(Joins sheet 74)
(Joins sheet 80)
(Joins sheet 82)
(Joins sheet 87)
2 770 000 FEET
285 000 FEET
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
1000
2000
3000
4000
5000
MONTGOMERY
COUNTY
PHILADELPHIA
(county seat)
Bustleton
Normandy
West Torresdale
NORTH PHILADELPHIA
AIRPORT
READING
ROOSEVELT
BOULEVARD
PENNYPACK
CREEK
Walton
Run
532
83
1
DoA
CaB
UdB
CeB
CeA
MaC
UdC
DuA
DuB
Ha
LgA
Ro
McE
MaD
MbD
MaB
MacE
CaA
Ub
Uh

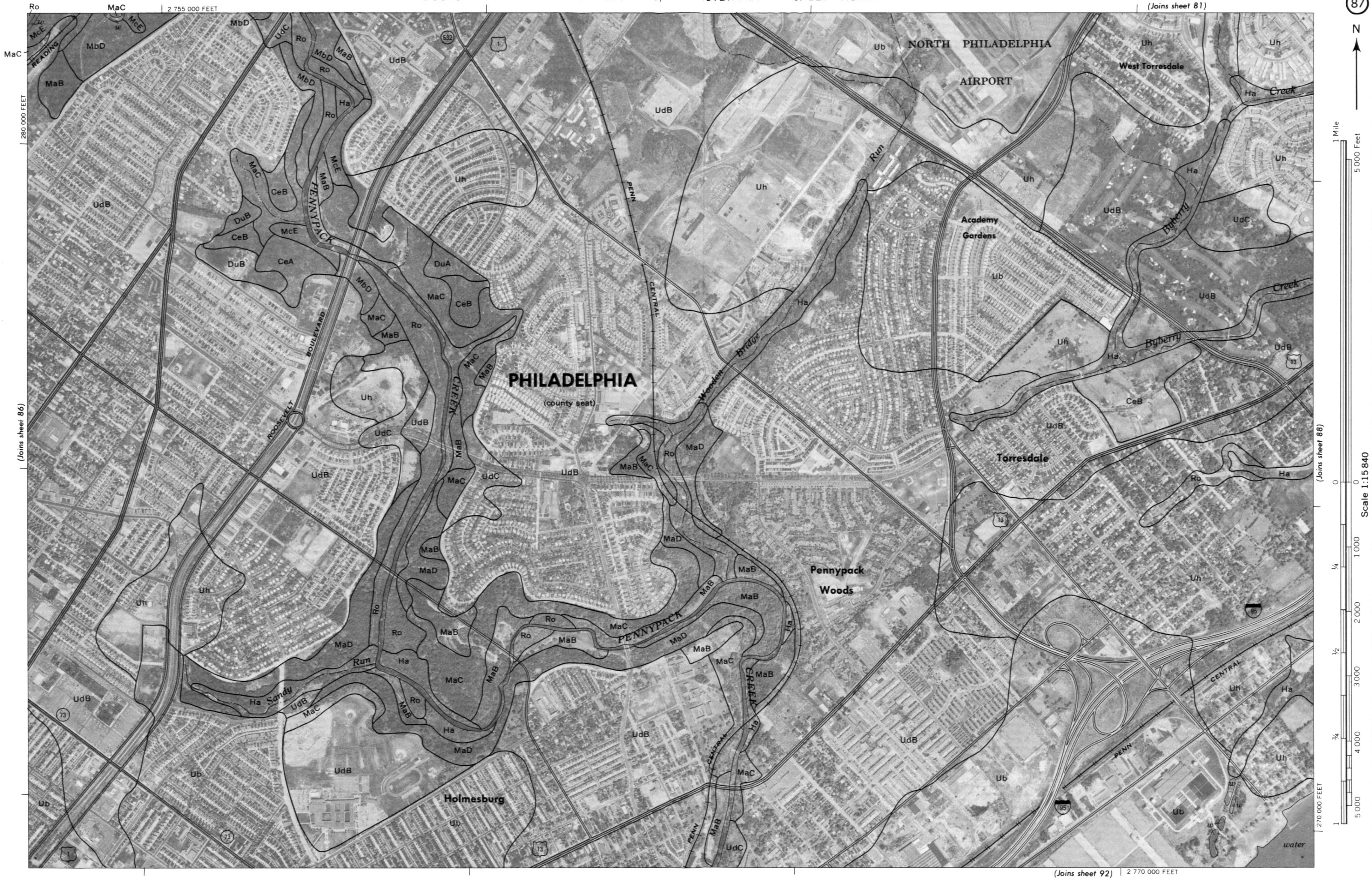

(Joins sheet 75)
(Joins sheet 81)
(Joins sheet 83)
(Joins sheet 88)
N
1 Mile
5000 Feet
Scale 1:15 840
2 790 000 FEET
295 000 FEET
285 000 FEET
2 775 000 FEET
PHILADELPHIA
(county seat)
Eddington Gardens
Eddington
Longmead Farms
LIBERTY BELL PARK
Golf Course
Benjaman Rush School
Snyder Jr High School
Peace Church
St Francis Vocational School
Holy Ghost School
Cornwells Church
St Charles School
QUARRY
water
Poquessing Creek
Black Lake Run
Byberry Creek
Walton Run
PHILADELPHIA COUNTY
BUCKS COUNTY
PENN CENTRAL
132
513
13
95
63
DuA
DuB
DoA
LgA
LgB
MaB
MaC
CeB
CeC
CaA
UrB
Ha
Uh
Uc
UdB
UdC
Ub
HoA
HoB
Fa
AgA
AgB
PpA
Ro

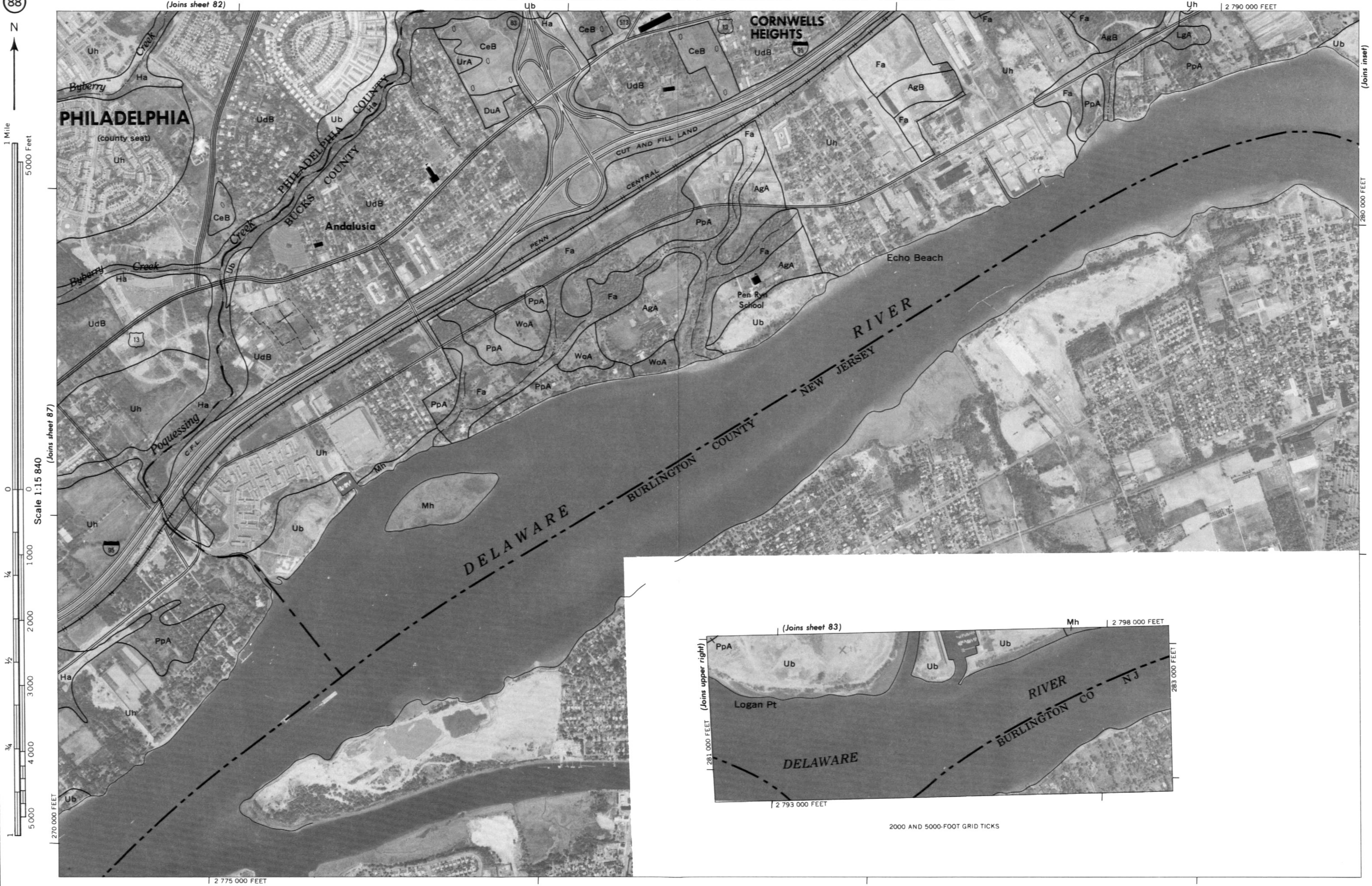

(Joins sheet 76)
2 795 000 FEET
295 000 FEET
83
N
Ellerslie
Grundys Corner
QUARRY
G.P.
CREEK
NESHAMINY
CROYDON
BRISTOL
BRISTOL CEMETERY
ST MARKS CEMETERY
PENN CENTRAL
ABANDONED
CANAL
Silver Lake
SEWAGE DISPOSAL
Maple Beach
DELAWARE RIVER
BURLINGTON COUNTY
NEW JERSEY
water
(Joins sheet 82)
(Joins inset, sheet 78)
(Joins inset, sheet 88)
285 000 FEET
2 810 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000

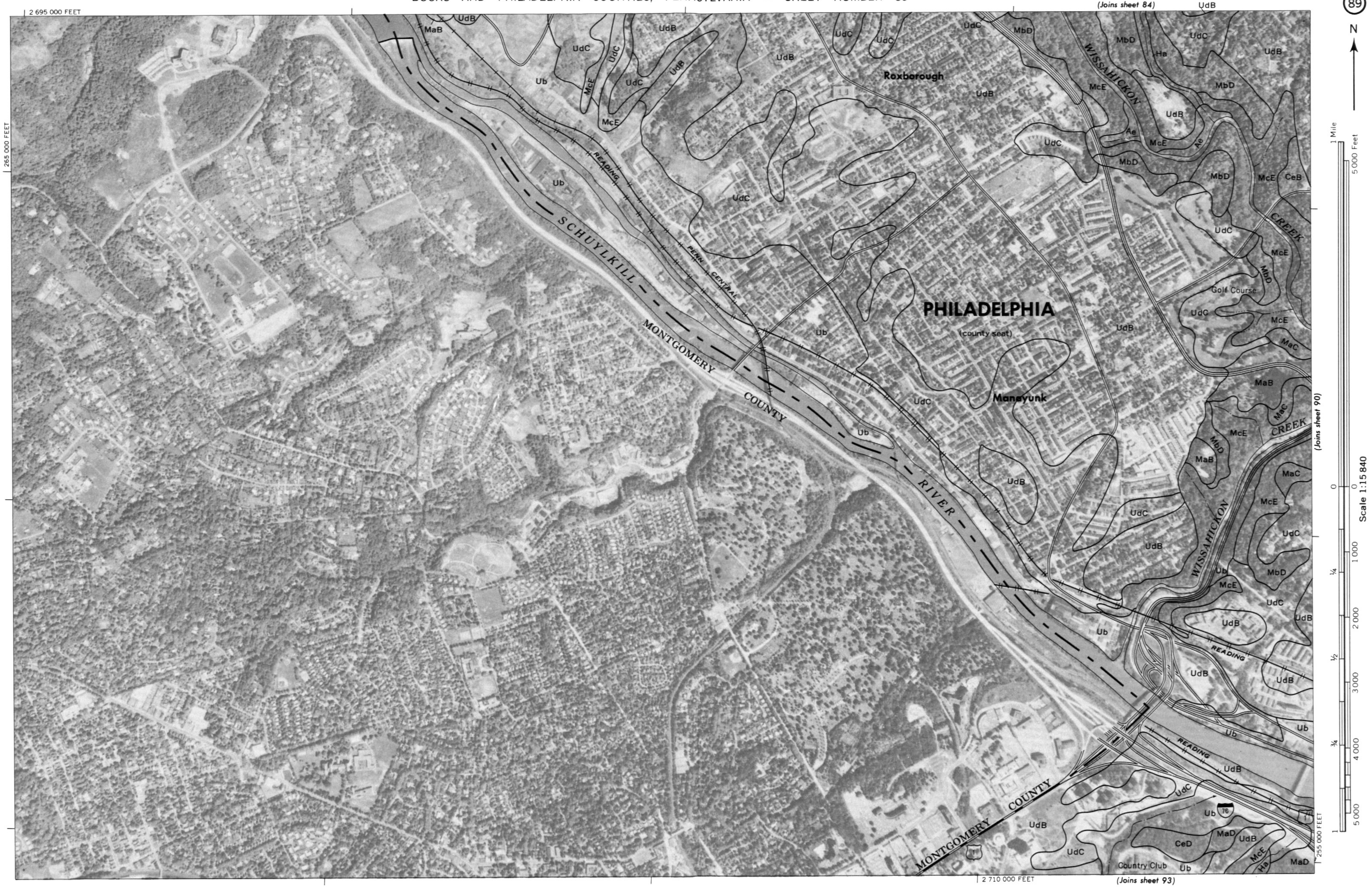

N
Scale 1:15 840
1 Mile
5000 Feet
2 710 000 FEET
(Joins sheet 79)
280 000 FEET
(Joins sheet 85)
270 000 FEET
2 695 000 FEET
(Joins sheet 89)
Chestnut Hill
PHILADELPHIA
(county seat)
St Martins
Shawmont
MONTGOMERY COUNTY
SCHUYLKILL RIVER
MONTGOMERY COUNTY
WISSAHICKON
CREEK
Cresheim
Creek
PENN CENTRAL
READING

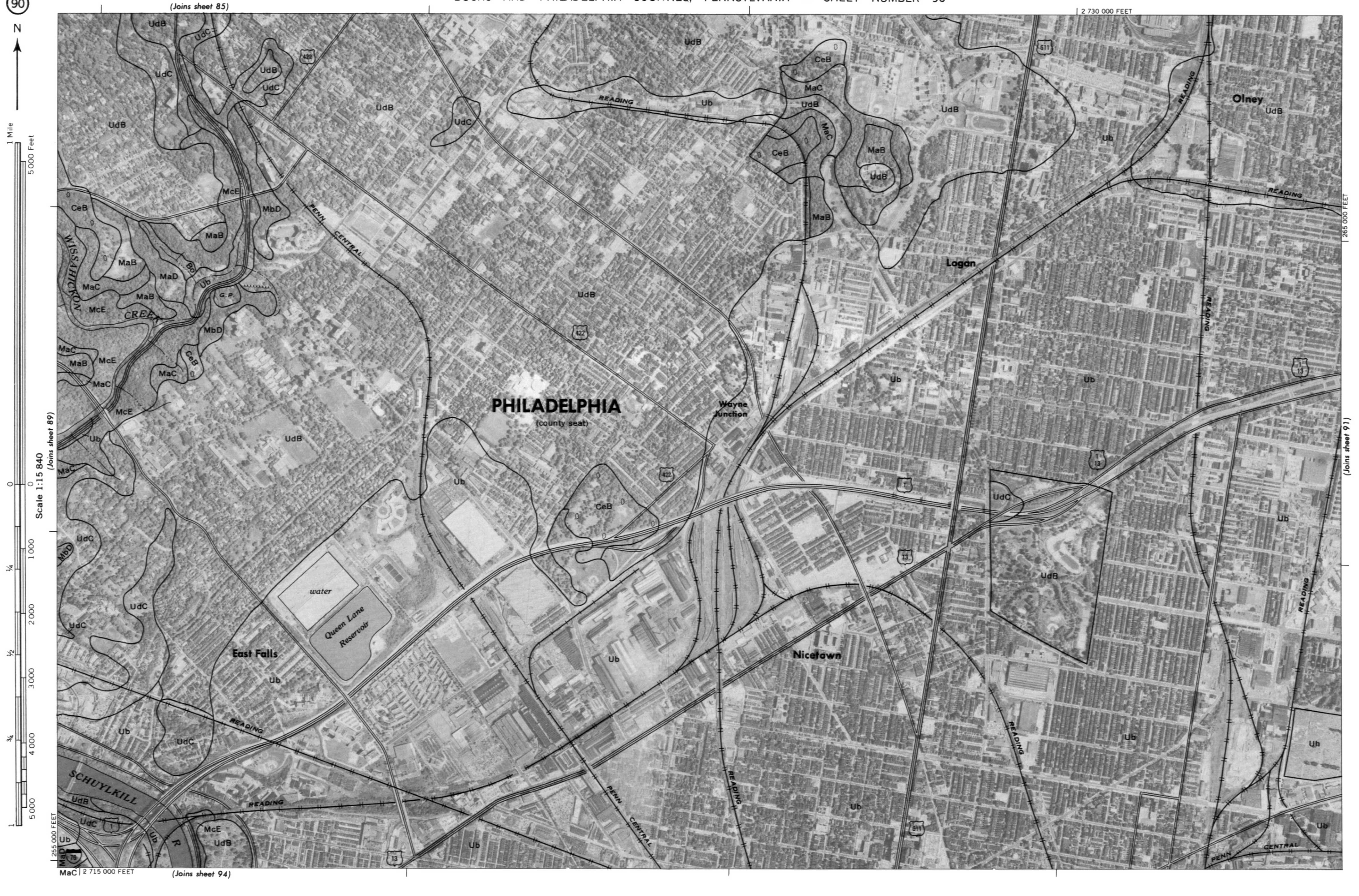

85
N
(Joins inset, sheet 79)
2 715 000 FEET
280 000 FEET
(Joins sheet 84)
(Joins sheet 86)
(Joins sheet 90)
270 000 FEET
2 730 000 FEET
MONTGOMERY COUNTY
PHILADELPHIA
(county seat)
GERMANTOWN
READING
PENN CENTRAL
Scale 1:15 840
1 Mile
5 000 Feet
UdB
Ub
Ha
MbD
CeB
UdC
MaB
MaC
CeC

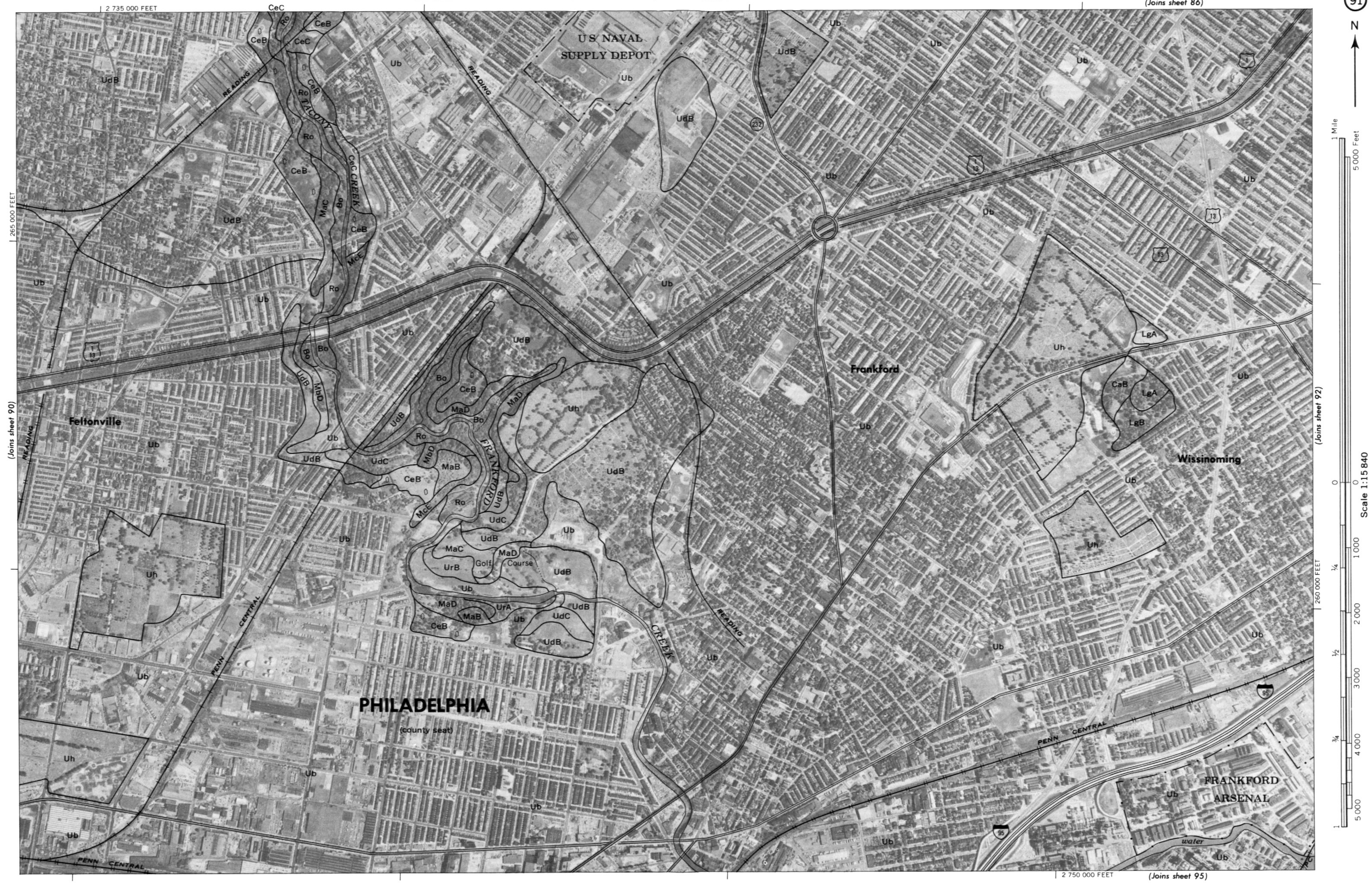

N
1 Mile
5000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1
(Joins sheet 80)
2 750 000 FEET
280 000 FEET
(Joins sheet 87)
(Joins sheet 85)
270 000 FEET
2 735 000 FEET
(Joins sheet 91)
MONTGOMERY COUNTY
PENNYPACK CR
READING
TACONY CREEK
Burholme
Rhawnhurst
Lawndale
Crescentville
PHILADELPHIA
(county seat)
U S NAVAL
SUPPLY DEPOT
water
water
UdB
UdC
Ub
UrA
UrB
MaB
MaC
MbD
McE
CeA
CeB
CeC
CeD
Ro
Ha
Ae

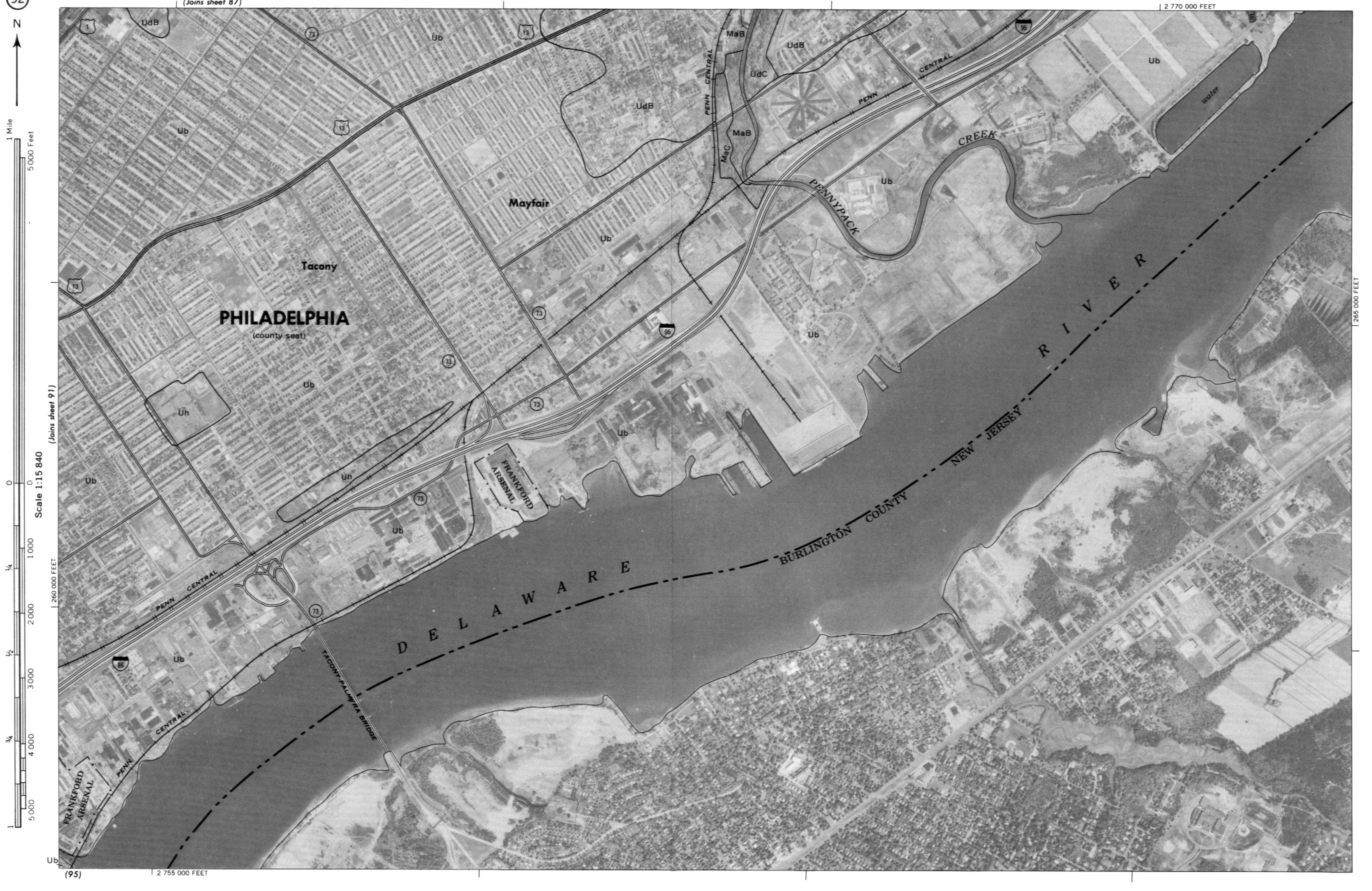

87
N
(Joins sheet 81)
(Joins sheet 86)
(Joins sheet 88)
(Joins sheet 92)
2 755 000 FEET
2 770 000 FEET
280 000 FEET
270 000 FEET
NORTH PHILADELPHIA
AIRPORT
West Torresdale
Academy
Gardens
PHILADELPHIA
(county seat)
Torresdale
Pennypack
Woods
Holmesburg
PENNYPACK
CREEK
Sandy
Run
Wooden
Bridge
Run
Byberry
Creek
ROOSEVELT
BOULEVARD
READING
PENN
CENTRAL
water
1 Mile
5 000 Feet
Scale 1:15 840

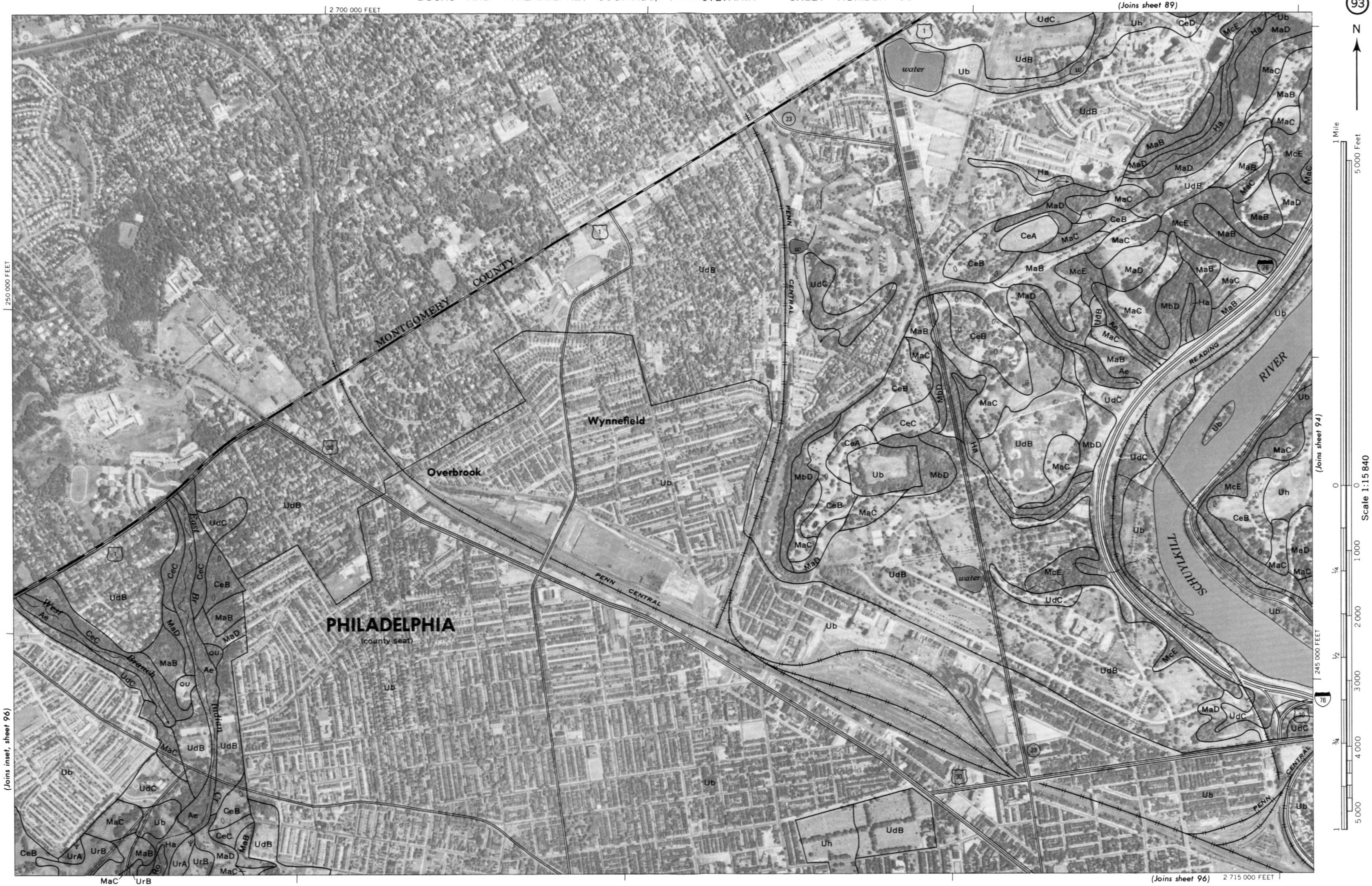

N
Scale 1:15 840
1 Mile
5000 Feet
(Joins sheet 82)
(Joins sheet 87)
(Joins inset)
2 790 000 FEET
280 000 FEET
270 000 FEET
2 775 000 FEET
PHILADELPHIA
(county seat)
CORNWELLS HEIGHTS
Andalusia
Echo Beach
Pen Ryn School
Byberry Creek
Poquessing Creek
PHILADELPHIA COUNTY
BUCKS COUNTY
CUT AND FILL LAND
PENN CENTRAL
C.F.L.
DELAWARE RIVER
NEW JERSEY
BURLINGTON COUNTY
Uh
Ha
UdB
Ub
CeB
UrA
DuA
Fa
AgB
LgA
PpA
AgA
WoA
Mh
(Joins sheet 83)
(Joins upper right)
Logan Pt
DELAWARE
RIVER
BURLINGTON CO
N J
2 798 000 FEET
283 000 FEET
281 000 FEET
2 793 000 FEET
2000 AND 5000-FOOT GRID TICKS


89
N
(Joins sheet 84)
(Joins sheet 90)
(Joins sheet 93)
2 695 000 FEET
265 000 FEET
2 710 000 FEET
255 000 FEET
PHILADELPHIA
(county seat)
Roxborough
Manayunk
SCHUYLKILL RIVER
MONTGOMERY COUNTY
WISSAHICKON CREEK
READING
PENN CENTRAL
Golf Course
Country Club
Scale 1:15 840
1 Mile
5 000 Feet

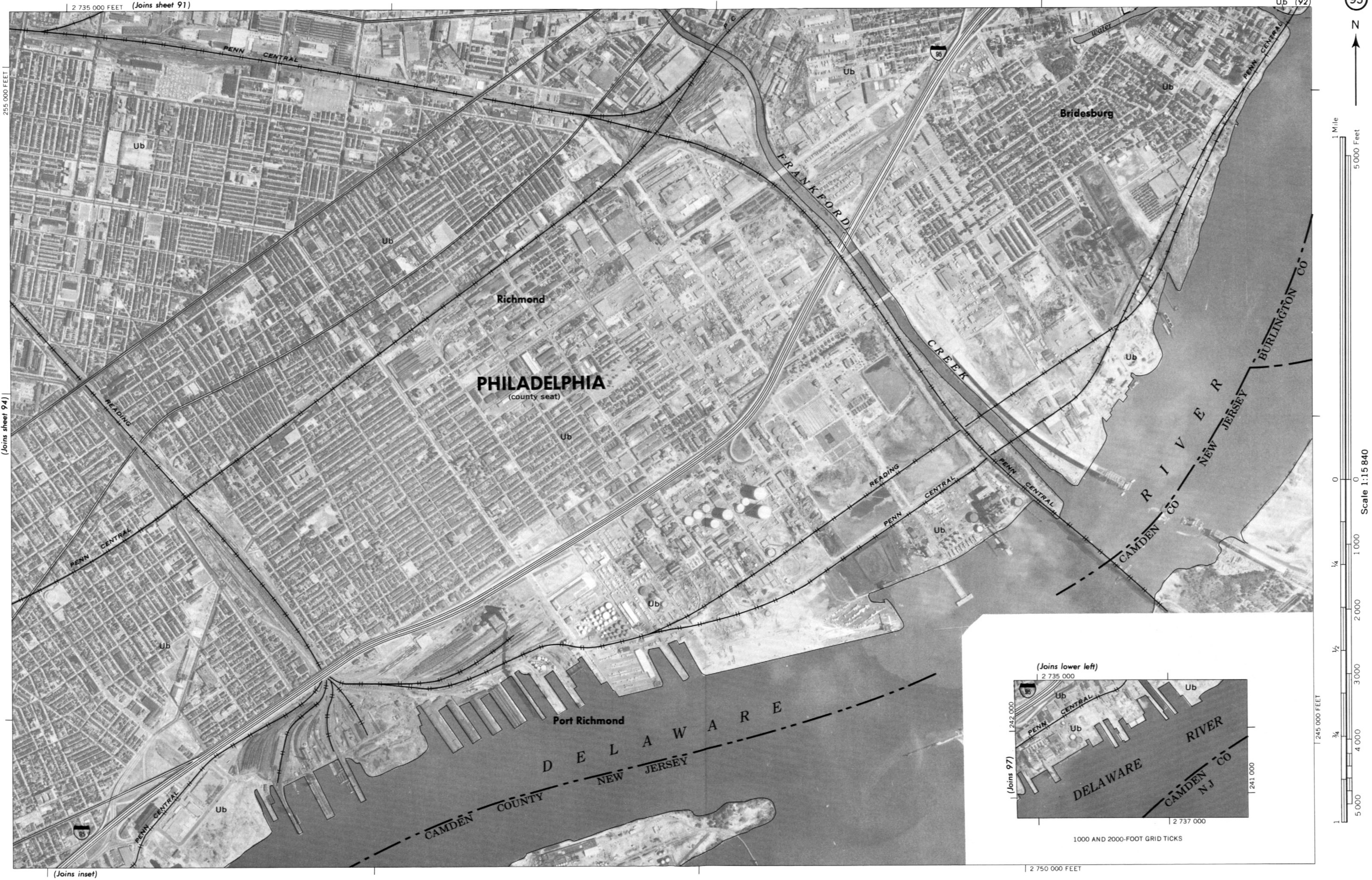

(Joins sheet 85)
(Joins sheet 89)
(Joins sheet 91)
(Joins sheet 94)
N
2 730 000 FEET
265 000 FEET
255 000 FEET
2 715 000 FEET
Scale 1:15 840
1 Mile
5000 Feet
PHILADELPHIA
(county seat)
Olney
Logan
Wayne Junction
Nicetown
East Falls
Queen Lane Reservoir
water
WISSAHICKON CREEK
SCHUYLKILL R
READING
PENN CENTRAL
UdB
UdC
Ub
CeB
MaC
MaB
MaD
MbD
McE
Bo
G.P.

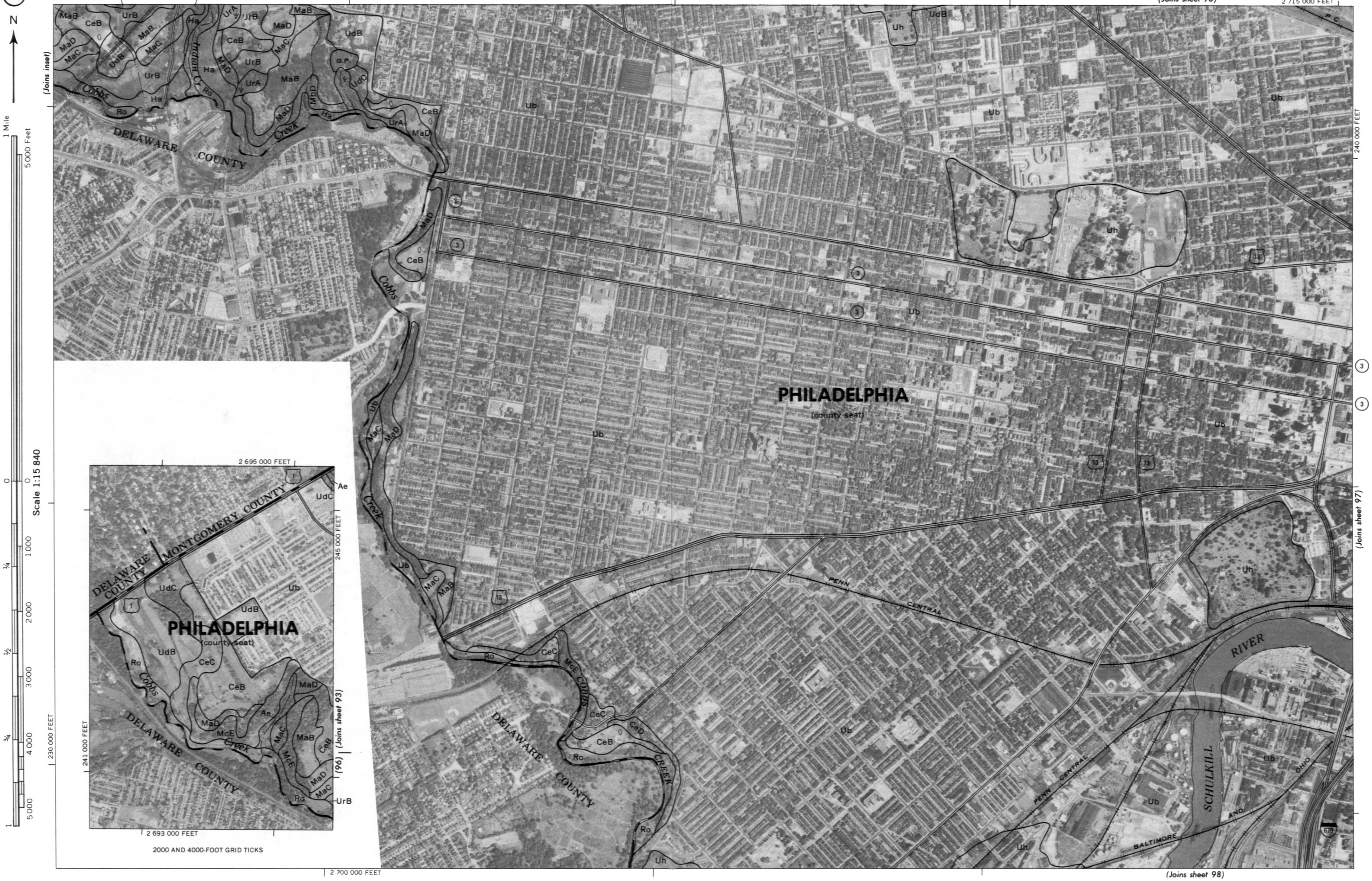

91
(Joins sheet 86)
(Joins sheet 90)
(Joins sheet 92)
(Joins sheet 95)
2 735 000 FEET
265 000 FEET
260 000 FEET
2 750 000 FEET
N
1 Mile
5 000 Feet
Scale 1:15 840
US NAVAL SUPPLY DEPOT
TACONY CREEK
FRANKFORD CREEK
Feltonville
Frankford
Wissinoming
PHILADELPHIA
(county seat)
FRANKFORD ARSENAL
Golf Course
READING
PENN CENTRAL
water
UdB
Ub
Uh
CeB
CeC
Ro
Bo
MaC
MaD
McE
MbD
MaB
UdC
UrB
UrA
LgA
LgB
CaB


(Joins sheet 87)
(Joins sheet 91)
2 770 000 FEET
2 755 000 FEET
260 000 FEET
265 000 FEET
N
1 Mile
5000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1
PHILADELPHIA
(county seat)
Tacony
Mayfair
DELAWARE RIVER
NEW JERSEY
BURLINGTON COUNTY
PENNYPACK CREEK
FRANKFORD ARSENAL
TACONY-PALMYRA BRIDGE
PENN CENTRAL
water
Ub
UdB
UdC
MaB
MaC
Uh
(95)

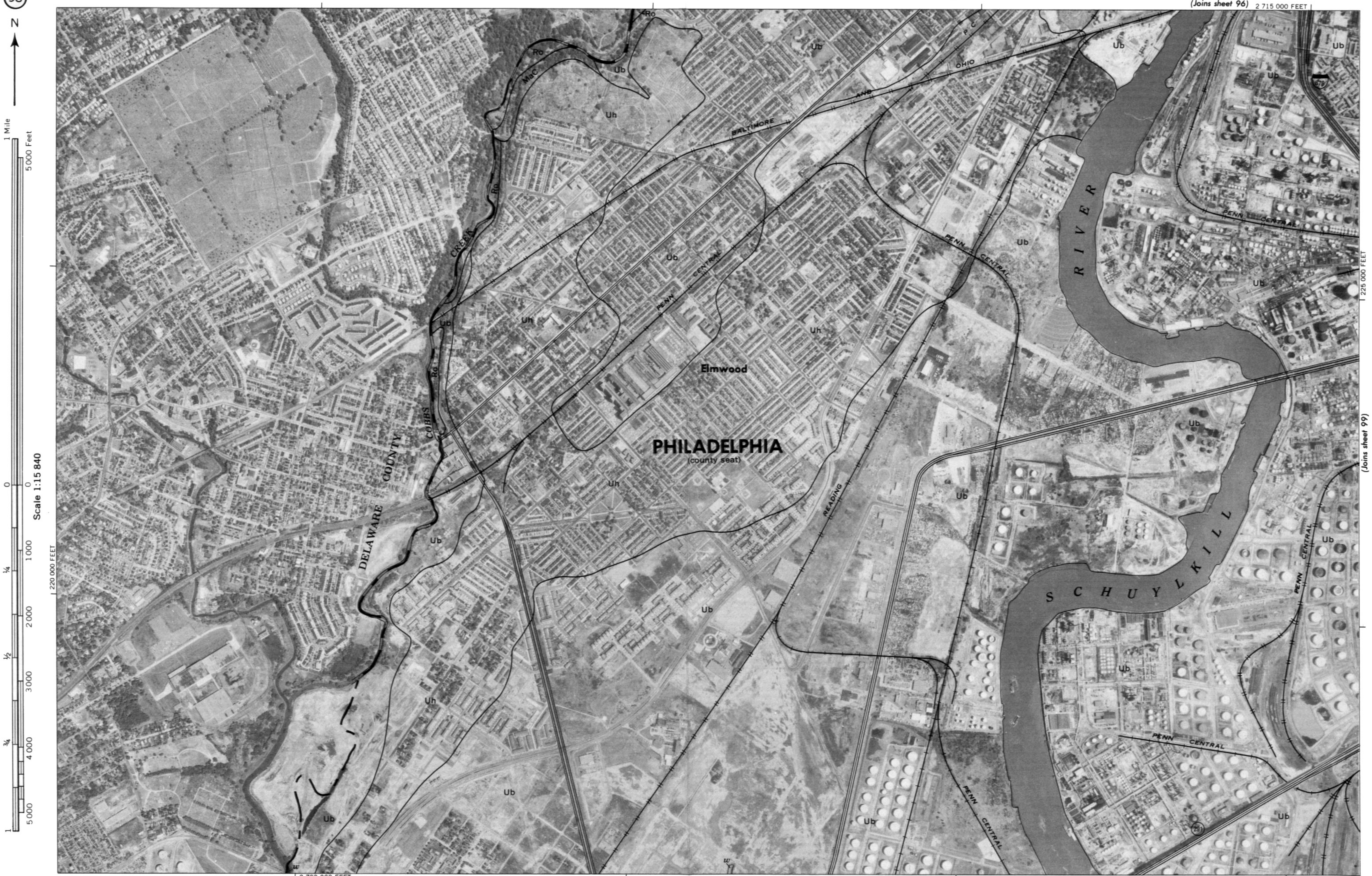

93
2 700 000 FEET
(Joins sheet 89)
250 000 FEET
245 000 FEET
2 715 000 FEET
(Joins sheet 94)
(Joins sheet 96)
(Joins inset, sheet 96)
N
Scale 1:15 840
1 Mile
5000 Feet
MONTGOMERY COUNTY
PHILADELPHIA
(county seat)
Wynnefield
Overbrook
PENN CENTRAL
READING
SCHUYLKILL
RIVER
East Br
West Branch
Indian
water


94
N
(Joins sheet 90)
(Joins sheet 93)
(Joins sheet 95)
(Joins sheet 97)
1 Mile
5000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1
2 730 000 FEET
2 720 000 FEET
255 000 FEET
245 000 FEET
SCHUYLKILL
RIVER
East Park
Reservoir
PHILADELPHIA
(county seat)
Kensington
Lemon
Hill
READING
PENN
CENTRAL
MaD
MaC
MaB
McE
UdC
UdB
Uh
Ub
Ae
CeB
CeC
w
76
13
611
30

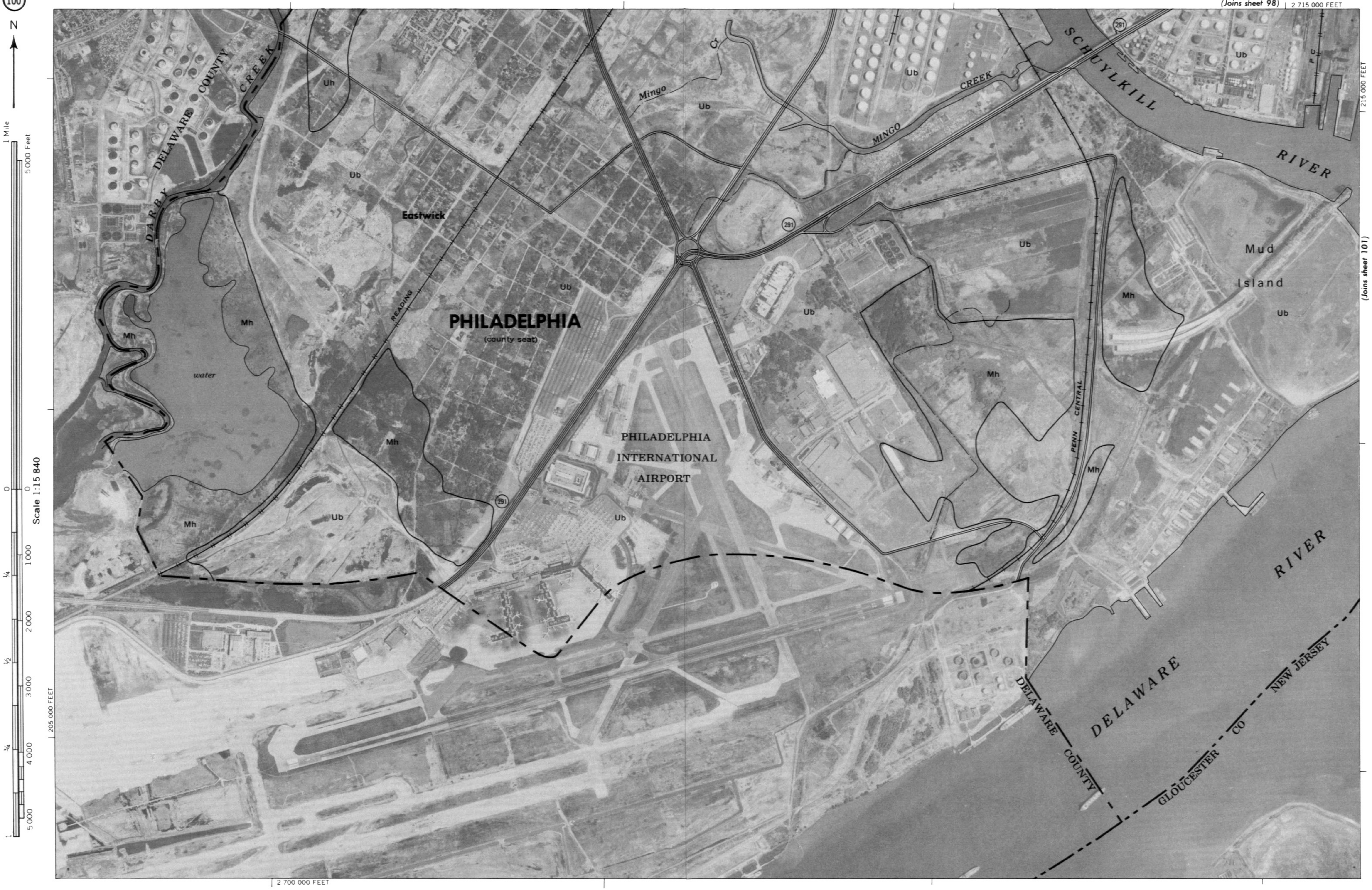

95
N
2 735 000 FEET
(Joins sheet 91)
Ub (92)
255 000 FEET
(Joins sheet 94)
(Joins inset)
2 750 000 FEET
245 000 FEET
PENN CENTRAL
READING
FRANKFORD CREEK
Bridesburg
Richmond
PHILADELPHIA
(county seat)
Port Richmond
DELAWARE RIVER
NEW JERSEY
CAMDEN COUNTY
CAMDEN CO
BURLINGTON CO
water
Ub
(Joins lower left)
2 735 000
242 000
241 000
2 737 000
(Joins 97)
DELAWARE RIVER
CAMDEN CO NJ
1000 AND 2000-FOOT GRID TICKS
1 Mile
5 000 Feet
Scale 1:15 840

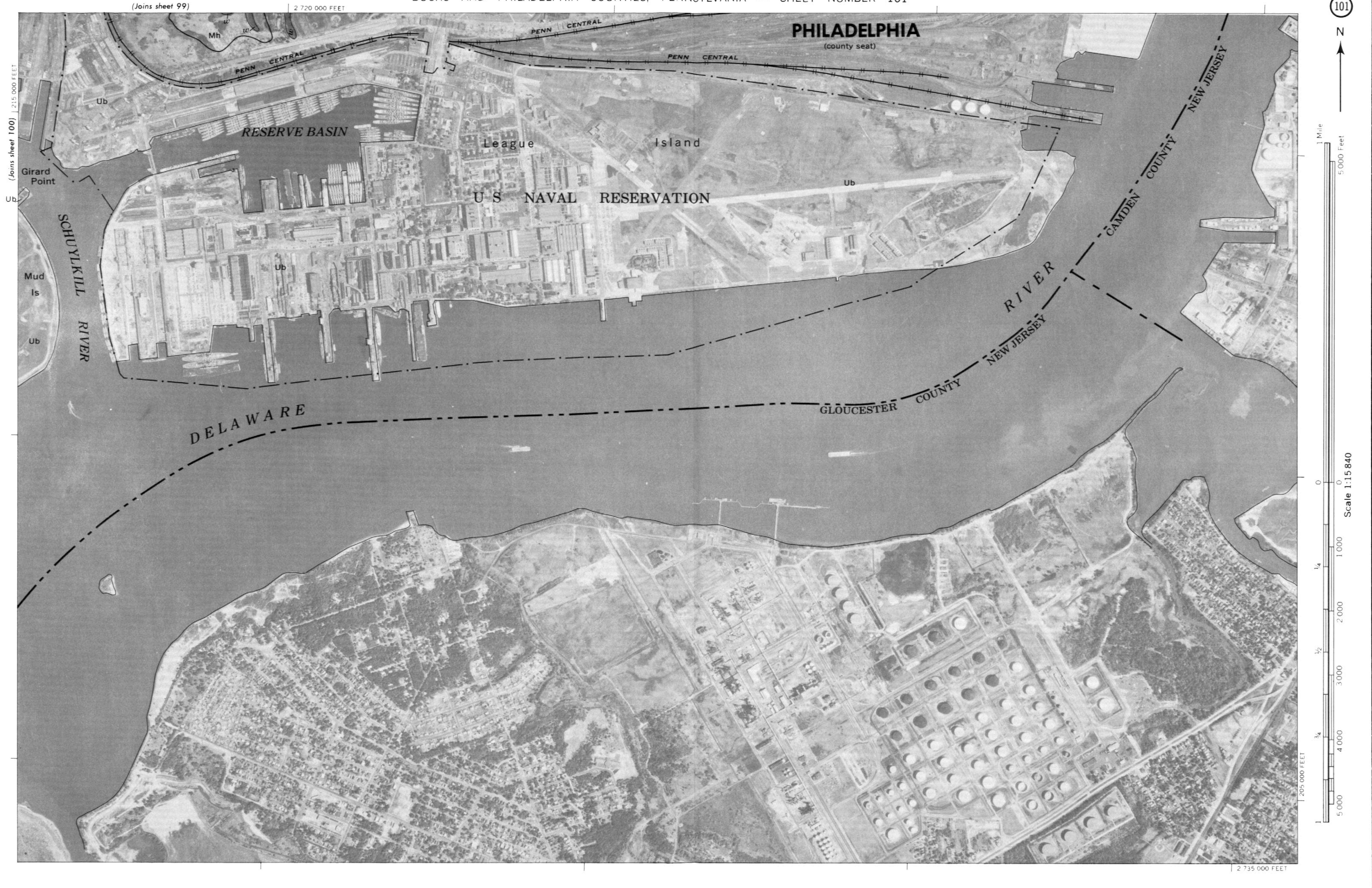

N
1 Mile
5000 Feet
0
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾
1
(Joins sheet 93)
(Joins inset)
(Joins sheet 97)
(Joins sheet 98)
2 715 000 FEET
240 000 FEET
230 000 FEET
2 700 000 FEET
PHILADELPHIA
(county seat)
DELAWARE COUNTY
Cobbs Creek
Indian Cr
SCHUYLKILL RIVER
PENN CENTRAL
BALTIMORE AND OHIO
Ub
Uh
UdB
UrA
UrB
MaB
MaC
MaD
CeB
CeC
CeD
McE
Ha
Ro
G.P.
2 695 000 FEET
245 000 FEET
241 000 FEET
2 693 000 FEET
MONTGOMERY COUNTY
DELAWARE COUNTY
UdC
UdB
Ae
(Joins sheet 93)
(96)
2000 AND 4000-FOOT GRID TICKS


(Joins sheet 94)
(Joins inset, sheet 95)
(Joins sheet 96)
(Joins sheet 99)
2 720 000 FEET
2 730 000 FEET
240 000 FEET
230 000 FEET
N
PHILADELPHIA
(county seat)
Independence Hall
SCHUYLKILL RIVER
DELAWARE RIVER
CAMDEN COUNTY
NEW JERSEY
FRANKLIN BRIDGE
PENN CENTRAL
READING
TUNNEL
BALTIMORE AND OHIO
Ub
UdB
UdC
CeC
McE
Scale 1:15 840
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1 000
2 000
3 000
4 000
5 000


98
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 96)
2 715 000 FEET
225 000 FEET
(Joins sheet 99)
(Joins sheet 100)
2 700 000 FEET
220 000 FEET
PHILADELPHIA
(county seat)
Elmwood
DELAWARE COUNTY
COBBS CREEK
SCHUYLKILL RIVER
BALTIMORE AND OHIO
PENN CENTRAL
READING
Ub
Uh
Ro
MaC
w


(Joins sheet 97)
2 720 000 FEET
Ub
99
N
(Joins sheet 98)
25 000 FEET
PHILADELPHIA
(county seat)
PENN CENTRAL
676
291
Tollgate
WHITMAN BRIDGE
DELAWARE RIVER
CAMDEN COUNTY
NEW JERSEY
CAMDEN CO
water
Mh
w
Golf Course
U.S. NAVAL RES
Meadow Lake
220 000 FEET
(Joins sheet 101)
2 735 000 FEET
Scale 1:15 840
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
¼
½
¾
1


N
1 Mile
5000 Feet
Scale 1:15 840
0
1000
¼
2000
½
3000
¾
4000
5000
1
(Joins sheet 98)
2 715 000 FEET
215 000 FEET
(Joins sheet 101)
205 000 FEET
2 700 000 FEET
DARBY
DELAWARE
COUNTY
CREEK
Uh
Ub
Mingo
Cr
MINGO
CREEK
SCHUYLKILL
RIVER
291
Ub
Eastwick
READING
PHILADELPHIA
(county seat)
Mh
water
Mh
Mh
Ub
Mh
PHILADELPHIA
INTERNATIONAL
AIRPORT
Ub
Ub
Ub
Mh
Mh
PENN
CENTRAL
Mh
Mud
Island
Ub
DELAWARE
RIVER
DELAWARE
COUNTY
GLOUCESTER
CO
NEW JERSEY


(Joins sheet 99)
2 720 000 FEET
(Joins sheet 100)
215 000 FEET
PHILADELPHIA
(county seat)
PENN CENTRAL
PENN CENTRAL
PENN CENTRAL
Mh
Ub
RESERVE BASIN
League Island
US NAVAL RESERVATION
Girard Point
SCHUYLKILL RIVER
Mud Is
DELAWARE RIVER
CAMDEN COUNTY NEW JERSEY
GLOUCESTER COUNTY NEW JERSEY
101
N
1 Mile
5 000 Feet
Scale 1:15 840
205 000 FEET
2 735 000 FEET